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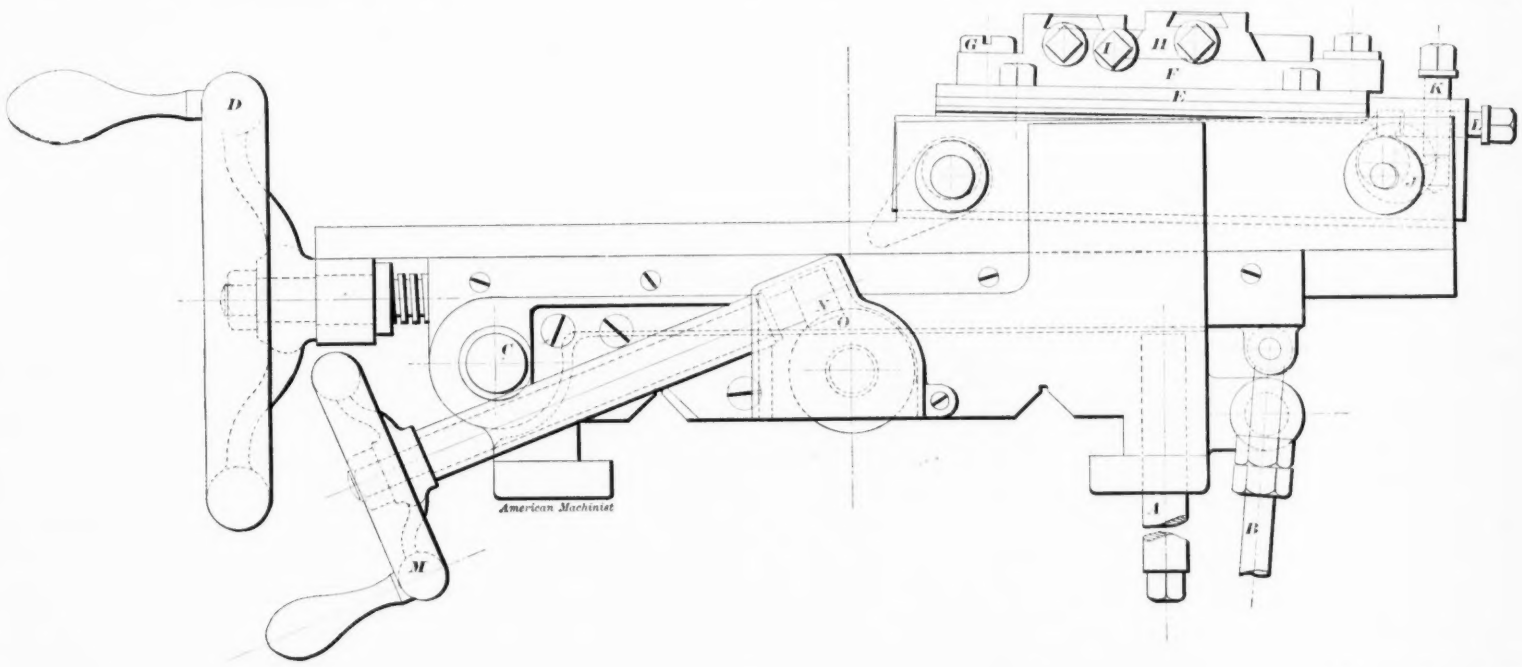
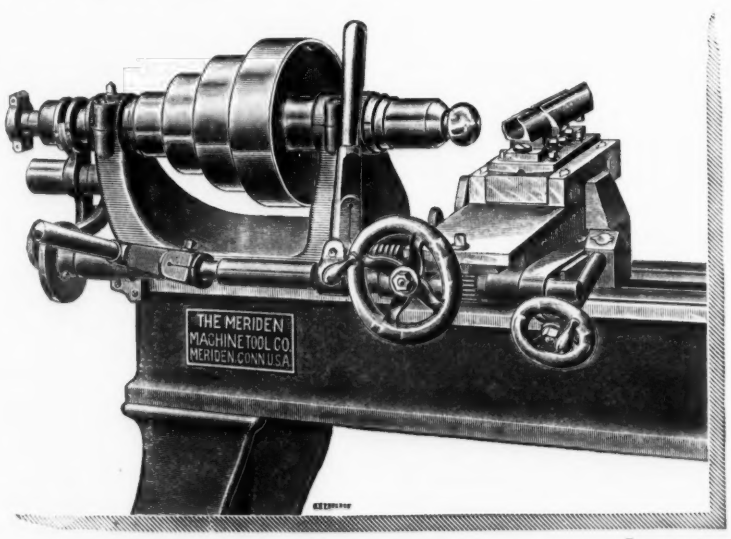
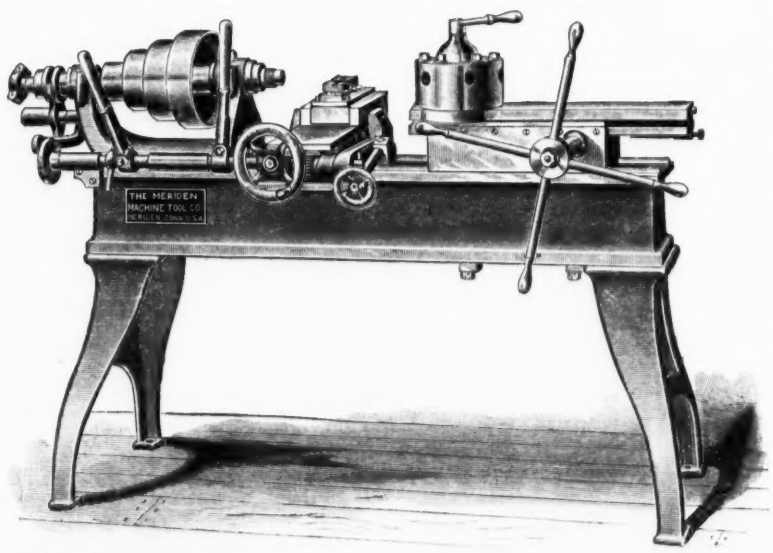
Improved Forming Lathe.

Meriden, Conn., is the headquarters of silver-plated ware manufacturing, and the forming lathe of the Meriden Machine Tool Co. was originally designed to turn the knobs, tips, pillars, caster stems, bottle tops, etc., etc., that are used for trimmings on silver-plated ware. These trimmings are made of britannia and other soft metals, are cast in metal molds, and, in consequence, the castings are all exactly alike, have no scale, and, of course, are free from sand, etc. After the forming lathe had been some time in use for this class of work, the advantages of the principle on which it works became so apparent that manufacturers of brass goods (and similar work) began to make use of the forming lathe, which even in its original form was so far ahead of all previous methods of finishing brass castings to shape, that its disadvantages were not at first taken into account. These disadvantages were that it was hard to adjust the tool to turn an exact size (this not usually being necessary on soft metal work); that the carriage must be rapped back and forth to make up for variations in the lengths of castings, and that the edge of the tool was often destroyed by scale and sand.







IMPROVED FORMING LATHE.

The improved forming lathe made by the Meriden Machine Tool Co. has none of these disadvantages, and is claimed to be a perfect brass-working tool within its line and capacity. The lathe is made with a foot block for manufacturers of door-knobs, etc., where only turning is required, and with a turret for valve work, etc.

The great advantage peculiar to the original forming lathe, of being able to do all the work on such pieces as can be held in either an expanding or contracting chuck by means of one lever, and without stopping the lathe, is retained in the new lathe, and the improvements whereby the lathe is adapted to working brass castings may be understood by reference to the drawing on this page. It will be seen that the whole tool carriage is raised or lowered and clamped tight at any height by means of the screws *A* and *B*. As the front of the carriage swings about the center of the shaft *C*, the rack and pinion will, of course, work correctly regardless of the height of the carriage. The tool carriage may be worked by a screw on long or heavy cuts by means of the wheel *D*. The plate *E* on which the tool-holder *F* rests may be rocked sufficiently to adjust the tools for turning the proper diameters at both ends of a piece. The tool-holder has a radial adjustment around the stud *G* sufficient to give clearance on shoulders or approximations to shoulders, and when right and left-hand shoulders are to be turned on the same piece, as on unions and other steam-pipe fittings, tools may be made with two parts, one with right hand and the other with left-hand clearance, and held in the front and back part *H* of the tool-holder respectively. The back tool-holder *H* may also be used to hold a finishing tool adjusted to take a very fine and smooth finishing chip after a roughing tool held in the front has turned off the scale and sand if any, thus producing very smooth work without the necessity of frequent grinding. The back tool-holder is adjusted sideways by means of the screw *I* and for height in reference to the front tool by revolving the eccentric *J* one way or the other by means of the screws *K* and *L*. This raises or lowers the cutting edge of the back tool without practically changing the cutting edge of the front tool, which is approximately over the center on which the piece that carries the tool holders swings. It will be noticed that all adjusting screws push against each other, so that the adjustments remain firm after the screws are worn.

Other uses for the double tool holder will readily suggest themselves to those having them in use, such as mounting a knurling tool or a cutting-off tool in the back holder, etc. Another important improvement is the longitudinal adjustment of the whole tool carriage. It will be seen by the drawing that this is gibbed to the bed, and it is adjusted to and from the head by means of a square-threaded screw running in a bronze nut in the head; this screw is revolved by means of the wheel *M* working through the spiral gears *N* and *O*. A quarter of a revolution of this wheel moves the carriage about one sixty-fourth of an inch, and this feature will be fully appreciated by those who have heretofore been obliged to rap the carriage back and forth, in order to have the castings clean up properly.

We give also an enlarged view of the head and forming tool-slide, designed to show more in detail the appearance and working of the forming part of the lathe; a door-knob is shown held in the chuck. The lever near the front of the head is the one that is used for rapid work, the operation being as follows: The first part of the motion of this lever tightens the chuck, working through the shaft, link and cam, and the sleeve and fingers shown at the left; the continuation of the motion brings the forming tool forward under the work, and turns it to shape; at this point the tool drops automatically sufficiently to clear the work when the motion of the lever is reversed, and raises to its normal position again at the end of the reverse motion of the lever, at which time the chuck has been released, and the piece is free to be removed. The cutting edge of the forming tool being ground to an angle in relation to its length, begins to cut at one end of the piece, and cuts gradually along to the other end, the cut being no harder than when a slide-rest is used to turn roughly to shape, and is done as quickly as an expert man can take one chip with the slide-rest, with the great advantage that this one operation finishes the turning as smooth as it can be planished by hand, and with the further advantage that no special skill is required on the part of the operator.

When doing turret work, or when for any reason it is not desirable to have the chuck

loosen when the tool-slide is in its back position, the shaft is disconnected by simply sliding the sleeve; the chuck is then tightened by means of the left-hand lever, and remains tight until released. Either of the levers may be unclamped and allowed to hang free when not in use, and the stop shown next the left-hand lever may be set to keep the lever in a convenient position when used for tightening the chuck. A tool-post is mounted on the front of the forming tool-slide when ordered, the advantages of which on some work are so obvious that no particular explanation is necessary.

The turret is very heavy; the lock bolt is 11½" long, and is backed by a spring 12" long; it is supported its whole height by solid metal one side and a taper gib the other side, and enters the index ring almost directly under the tools. The construction of the turret slide is such that no strain is brought at the back end of the stroke, on the parts that revolve the turret, no matter how hard or how rapidly the slide is run back.

Vanderbeek's countershafts are furnished with the turret lathes.

How to Repair Broken or Cracked Castings—II.*

By S. Bolland.

Sometimes a casting is broken after the manner shown at *A*, Fig. 4. When it is thought best to burn such a job on its flat, and the broken piece cannot be found, let a casting be made answering to the form required, taking care to cut away the skin at the part to be joined; these can then be laid together and fused, as will be explained further on. Much anxiety and trouble might be saved sometimes if, when immediately the casting is poured and there is a doubt as to its soundness, the cope was lifted and the holes, if any are found, were burned at once whilst the casting is red hot.

Another important feature in burning on a new piece, such as a tooth of a wheel, etc., is to so place the casting that the molten iron will be sure to pass over the whole surface, and also to make such an outlet at the *lowest* part of the fracture as will insure a steady outflow of the cooled iron after it has been forced over the surface to be fused; Fig. 5 shows a spur gear fixed so as to answer these conditions.

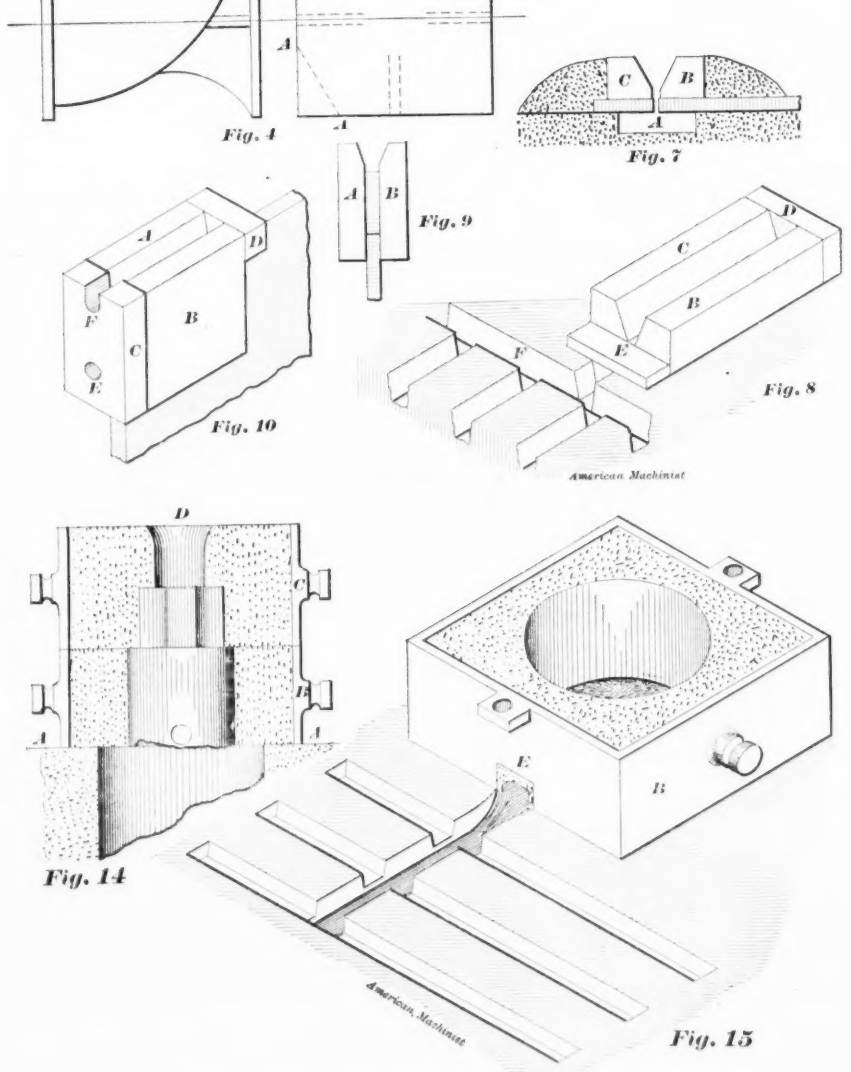
If after failure to effect a junction it is thought advisable to make a second attempt, be sure to cut the burnt portion away until the good graphitic iron is found; the partially decarbonized iron previously in contact with the molten iron would effectually preclude all possibility of a second fusion at that place.

Burning on to, or attaching cast iron to steel when the surface to be acted upon is considerable, is attended with much difficulty on account of the conditions previously spoken of; but here again it is worthy of notice that the nearer the two metals can be brought together in temperature before pouring, the less danger there will be of ultimate rupture from internal strains. To this end the steel to be cast on should be heated to as high a temperature as possible, and set into a suitably prepared dry mold, the latter to be instantly closed, and very hot iron dropped from a considerable height directly upon it.

Fig. 6 shows a temporary method of casting a flange on a pipe. This is not a burning process; as the pipe to be thus treated must first have a notch cut round its circumference, as seen, and being set on end in the floor the flange is formed by means of a pattern, using a covering flask and gating in the usual manner. The rigid pipe naturally interferes with the contraction of the new flange, so that this method is limited to pipes of small diameter. Wrought pipes can readily be provided with extemporized flanges of this kind, the thread end forming an excellent fastening.

Going back to Fig. 4 we will endeavor to show how a casting of this kind may be repaired. The figure represents an elbow pipe 36 inches diameter with square base attached. Should the piece at *A*, *A* be broken off it may be fused to the casting by following the directions given. Let the casting, previously made as hot as practicable, be sunk into the floor and place the first core, *A*, Fig. 7, directly under the fracture, evenly divided as seen; the piece to be attached is then set in its place, slightly apart from the main piece, so that the molten iron can find its way uninterruptedly between; cores *B*, *C*, *D* and *E* are then set in position as shown at Fig. 8. These cores are then to be backed firmly with sand, as shown at Fig. 7, and weighted down; the pig bed *F* is then formed, and all is ready for the iron.

With a ladle, after the manner shown in Fig. 3, a steady stream of hot iron can be continuously directed along the line of the fissure; core *D* being as high as the side cores *C* and *B* prevents the iron from escaping in that direction, it must therefore



How to Repair Broken or Cracked Castings.

all pass out over core *E;* the latter core being raised only one inch higher than the casting permits the cooled iron to flow rapidly away into the pig bed *F*. When these jobs are so placed that the traveling back and forth can be accomplished by means of the racking gear on the crane, the operation is materially facilitated. An assistant with a rod of iron to feel along the bottom will soon discover when both sides of the fissure are fused, at which point it is advisable to cease pouring, for reasons already adduced.

Core *E* being one inch higher than the casting, and the latter being set level in the floor, will allow sufficient iron to remain in the channel for finishing, therefore, when the pouring has ceased it is only necessary to cover the molten surface well with charcoal, and to subsequently lay a few hot scraps over all to prevent too rapid cooling at that part. It is not wise to overdo this piling on of scrap as some do, all that is required is to bring about equal cooling of the whole piece as soon as possible.

It might be thought best to repair this or any other similar job with the web on edge, in which case all that would be required would be to set cores *A* and *B*, as seen at Fig. 9, with the additional cores *C* and *D*, as seen at Fig. 10. These cores must all stand 3 inches higher than the edge of the casting; the opening *E* allows the cooled iron to pass into the pig bed until the whole surface has been fused, when a clay plug on the end of the cupola man's "bod stick" can be inserted at *E*, the pouring continuing uninterruptedly in the meantime, until the metal flows out at the opening *F*. This opening, being as in the other cases one inch above the surface, leaves ample metal for finishing purposes.

To burn a tooth on a wheel is not a difficult matter if proper means are taken for doing it; the difficulty lays rather in preventing the casting from breaking during the operation. If the wheel to be thus mended is a spur, it is best to set it down in the floor on solid bearings in about the position shown at Fig. 5, *A*, *A* being the floor line. Joints *A* and *B* can then be formed, and flask *C* fashioned to suit. A tooth pattern being made to fit the broken surface correctly, the flask is rammed and the impression taken in dry sand facing, the pouring gate *D* being formed at the same time. The outlet *E* is cut, as seen at the lowest point of the tooth, runs under the flask, and is connected with the pig bed *F* when the final preparations are made.

When joint *B* is formed it may, if thought desirable, be secured to the wheel and there remain. The underside of the wheel adjacent to the broken tooth must be formed in dry sand after the most approved fashion; by this means the wheel can be lifted off the bearings and taken elsewhere to be heated. When the cope is dry and the wheel hot enough, the latter is again set down in its original position, the cope placed on and secured, and the pig bed made. Inasmuch as this style of burning is essayed in a closed mold it depends entirely on experience and judgment as to how much iron is required for complete fusion by this method. When sufficient for the purpose has been run through, stop the outlet at *G*, as previously instructed, but don't cease pouring until the metal shows at *D*.

To burn a tooth on a bevel wheel is in all respects similar to the preceding case, except that, owing to the angle of the teeth being favorable for the purpose, the wheel may be set level on the floor, as seen at Fig. 11.

To connect the two broken ends of a cracked wheel or pulley arm is, perhaps, as critical a job as could be attempted, and requires more than ordinary watchfulness in heating the casting. Fig. 12 represents the arm resting, with core *A* set directly under the crack, and cope *B* with gate *C* rammed over the top; the outlet is shown at *D*. As this operation is to be effected in a closed mold also, and fusion produced only by constant contact with the flowing metal and not by friction of the fluid iron over the surface as more or less occurs in the preceding cases, there must be no mistake about the iron being as hot as it is possible to make it.

This is one of the instances where there must be no more new metal added than is absolutely necessary to effect a junction, otherwise the local shrinkage of the added metal will be sufficient to separate it again, even after a good join has been made. Fig. 13 shows position of runner, form of covering flask with running gate *A* and outlet *B*. A very excellent way to insure a good clean surface which will yield quickly to the fusing influence of the molten iron, is to drill ¼-inch holes along the entire crack clean through, a very small amount of hot iron is then required to effect a perfect junction of the two parts. The heating of such castings as these may be done after the manner described for gear wheels, but the greatest circumspection must be exercised otherwise disaster will ensue, as the casting will break elsewhere.

As previously affirmed, the burning of shafts, rolls, propeller blades, etc., is more easy of accomplishment than any of the other cases cited. All that is necessary is to have the casting hot, and all the parts to be added, as well as all cores needed, previously prepared in dry sand. We will suppose a 24-inch roll with the neck broken off close to the body; this will necessitate the burning on of a new 14-inch neck with wabbler attached. Fig. 14 shows a section of said roll endwise in the floor with its broken end upwards and level with the floor line at *A*, *A*. The two flasks *B* and *C* containing mold for neck and wabbler, also rising head *D*, are shown as set thereon and ready for filling with iron.

When the casting has been rammed up to the top, and the joint *A* is formed level all round, flask *B* is set central thereon, as seen at *B*, Fig. 15, and a cast plate, with a hole equal in diameter to the neck, is carefully placed on the flask. This plate, if heavy enough, may act as weight for holding down as well as shield to protect the top joint. The connection of the outflow with the pig bed is then made, as seen at *E*, and all is ready for the iron, of which, for a job of this description, from 1,500 to 2,500 pounds, according to temperature, is needed. Fusion of the whole surface is best accomplished by directing the stream at different parts alternately, and at the same time rubbing the surface over with a ¾-inch rod bent for the purpose. The person whose business it is to test the operation as it progresses will soon discover the points least affected, and direct the stream of molten iron to be changed accordingly. As soon as the whole surface has been fused the outlet is plugged, and that portion of the mold filled to within an inch or two of the top. The surface of the molten iron in the mold is then freed from all scum and dirt and the plate lifted off, after which, when the joint has been cleaned, flask *C* is placed in position and secured. When this has been done the remaining portion of the mold is filled through the rising head *D*, nearly level with the top, and the same system of feeding is followed out as for a roll cast ordinarily.

* Some of the cuts referred to will be found in the issue of March 23.

New Tool Block for Cutting-off Machines.

The cut represents an improved form of tool block, and a carriage for cutting-off lathes, which has a number of novel features. In place of the rectangular binding posts, carrying one of the well known forms of holder with inserted blades, these blocks carry the blade in a recess in the side of the block itself, to which they are clamped solidly by a cap and bolts.

The blades are inclined at an angle to the line of travel to give a shearing cut. The width of the blades is a little greater than the radius of the largest sized stock to be cut, and the blocks are of such a form as to support the blades under the cutting edge, thus removing all chance of springing.

Instead of making the blade very wide in large-sized machines, the piece of hardened steel under the blade is made high and thin to extend under the blade into the cut.

The flat springs shown serve to hold the blade in position while being clamped by the cap bolts.

These blades are carefully ground on a special machine, on the top, bottom and sides, thus insuring straight blades with ample clearance.

They can be set in but one position in the blocks, and when thus set, cut off square every time.

As might be expected, these blades cut faster and heavier than the old ones, rolling out a heavy spiral chip instead of the short pieces scraped off, and the surface left by the blades is quite smooth. It is made by the Hurlbut-Rogers Machine Co., South Sudbury, Mass.

Portable, Pneumatic Tapping, Drilling and Reaming Machine.

The accompanying illustration is of a portable machine for drilling, reaming, or tapping holes, using air or steam pressure.

It is essentially a rotary engine, the speed of which can be regulated or its motion reversed (as for backing out taps) by turning the hand-wheel. It can, of course, be used in any position, and when drilling may be used with an ordinary brace or "old man," the same as a ratchet drill, a screw feed being substituted for the handle.

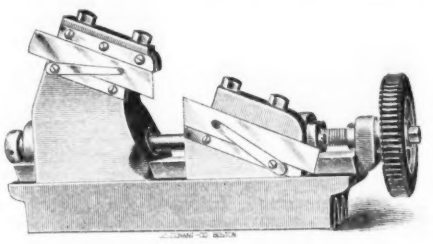
Two sizes are made, the smaller weighing 40 pounds, for holes up to ¾", and the other weighing 55 pounds, for holes up to 1¼". The maker is James T. Halsey, 26th and Callowhill streets, Philadelphia, Pa.

An Adjustable Snap Gauge.

The nature of the work done by the Cleveland Twist Drill Company requires an extensive use of snap gauges, and other means of accurately gauging work to standard size. Where many hundreds and even thousands of pieces are to be turned or ground to uniform size, fixed gauges wear, and, to be safe, it is best to frequently refer measurements to the micrometer caliper. To protect this last-named tool from too rapid deterioration by wear, and also perhaps from misuse in routine manufacturing operations, the adjustable snap gauge which we illustrate herewith was devised and has been used for some years with entire success.

The method of using this is to either make the first piece to the desired size by the micrometer, and then set the gauge to this first piece for making the others, or, where there is a standard plug or other male gauge of the proper size, to use this for setting the adjustable snap. Thus it is assured that there will be no serious departure from proper size, and, the adjustable gauge being quite inexpensive when compared with the micrometer, it can be liberally used, and saves the micrometer from much wear.

With the knurled jam nut it is not liable to be disturbed in adjustment, and by its use a snap gauge of any desired size is readily available, since, of course, it can be set not only at the regular or standard sizes, but at any size varying by fractions of a thousandth if desired, this being often especially desirable where an allowance is to be made for subsequent grinding, or otherwise finishing to standard. It is as useful for the inspector as for the workman, being set to standard by reference to the micrometer every time a lot of work is to be inspected. Having been so useful and satisfactory in the shops of its makers, they have decided



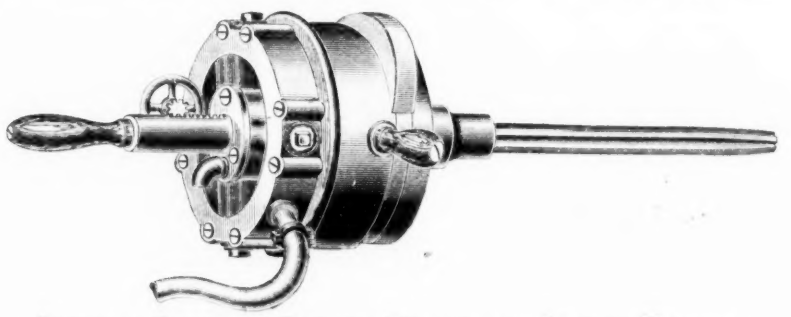
New Tool Block for Cutting-off Machines.

to make it for others' use, and are now manufacturing them in 1", 2" and 3" sizes. Not being intended for the same use, it is not, of course, made as finely as the micrometer caliper, the expense of this being unjustifiable, but it is well made for its purpose. The makers are the Cleveland Twist Drill Co., Cleveland, Ohio.

Shop Notes.

Editorial Correspondence.

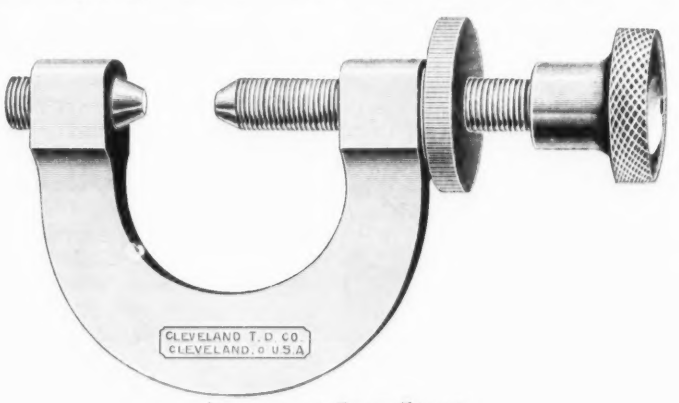
Torrington, Conn., seems to combine many of the features of an inland summer resort with those of a manufacturing town. It is beautifully situated between the hills which form the Naugatuck Valley, and draws its supply of water from them by a gravity system, the source of supply being at a sufficient elevation above the town to give all the head desired for any purpose.



Portable, Pneumatic Tapping, Drilling and Reaming Machine.

The town contains about 6,000 inhabitants, is growing rapidly, and is devoted mainly to manufacturing interests—tools, brass, sewing machine needles, bicycles, horseshoe nails, etc. A great many young men are employed in the shops and are helped in the acquirement of practical education, knowledge of drafting, etc., as well as socially, by an excellently equipped Y. M. C. A. building.

Another institution here which is somewhat remarkable in its way is a co-operative store where a large proportion of the mechanics of the town as well as others do their trading, and which transacted last year a business amounting to $71,000. Prices are as low or lower than elsewhere, and profits on the business are divided at the end of the year in proportion to purchases. Of course there is nothing new in this, as many such institutions have been started all over the country, but this is one of the few of them that have survived, and it seems to be doing well.



Adjustable Snap Gauge.

At the shops of the

HENDEY MACHINE COMPANY,

where I called mainly to see the new Norton lathe which we illustrated a few weeks ago, I found about 175 men busy, principally in making the well known Hendey lathes, planers and shapers.

The shops of this company have been built up from time to time as the necessities of a growing business demanded, and, as is usual in such cases, are not all that might be desired in the way of a machine building establishment; but latterly what building has been done has been with a view to having the best possible shops when all are completed and some parts of the present structure done away with, perhaps. It is the intention to build quite extensively this coming summer. Among the newer portions of the plant are a new brick office building, which is very pleasant and well arranged; over this being the drafting room, which contains every usual convenience as well as some that are not so usual. A fire proof vault extends through both stories of this building, the upper portion being in the drafting room and used for keeping drawings, while the lower portion is in the office and is used for storing books, records, etc. The drafting room is connected with the second story of the shops by a covered passage way or foot-bridge.

The shops are heated and ventilated by the Sturtevant hot air system, which, as in all the shops where I have seen it, or a similar system, is regarded as being in every way so far superior to any other method of heating as to be considered indispensable.

SOME HEAVY TOOLS.

Most if not all the work turned out of this shop, until quite recently, has been small, their products being limited to the smaller sizes of machine tools. Now, however, they are handling some heavier work, and on the day I called were shipping to the Long & Allstatter Company, of Hamilton, O., what is thought to be the largest shaper ever constructed. The ram of this shaper is 12 feet long and the stroke 6 feet; the bearing of the ram in the saddle being also 6 feet long. This machine is to be used in planing the slides and other parts of the heavy punching and shearing machines made at Hamilton, and there is to be a pit in front of it which will contain a large platen, adjustable vertically by hydraulic apparatus. Upon this platen the work will be placed, adjusted to the proper height and secured to the front of the machine by means of the T-slots provided, the regular platens being removed for that purpose.

On the floor at the time were also some heavy special machines which were being built for the new shops of Walter A. Wood & Co. These machines are to be used in boring frames of harvesting machines, and the beds are in the form of a cross, the frame to be bored being placed at the center or intersection of the four arms, upon each of which sliding carriages are placed which hold and drive the boring bars (six in number) which thus come into the work from four different directions at right angles to each other. All feeds are controlled and all handling of the machine done without the necessity for the operator changing his position. Two of these machines are being built and they constitute very interesting and creditable examples of special machine tool-building.

SPECIAL FIXTURES.

The moderate size of the regular lines of tools built here, and the fact that the magnitude of the business done admits of a considerable number of identical machines being constructed in one lot, permits the use of many special fixtures and devices. By the use of these some results are secured here which are by no means common with this class of work. For instance, head and foot-stocks of lathes are interchangeable, all these being scraped to fit scraping jigs which are in turn accurately scraped together, one of the pair being used to scrape the beds to.

In boring the heads for the main spindle boxes, for instance, the heads are bolted to a scraped seat which is the exact duplicate of the lathe bed, and they are secured to it by bolts in exactly the same manner as they are to be secured to the bed. This seat is part of a special machine which has two vertical boring bars driven at the bottom by a train of expansion gearing which allows of their being set at any required distance apart to bore the holes for the main bearings and for the back gears simultaneously, plates which are provided with properly located steel bushings being attached to each end of the casting to which the head is fastened and the bars being passed through these bushings. Automatic feeds are provided for by star wheels at the top of the bars which operate screws directly attached to them.

With these holes bored the other holes required in the heads are properly located and drilled or bored on drill presses, by using jigs.

A similar plan is adopted for the foot-stocks, these in fact being bored after being scraped and while fastened to the same fixture that is used for the heads. So accurately is this work done that when the lathes are assembled it is very seldom indeed that any correction has to be made for alignment, though the test to which they are submitted is a close one, a lapped ring or collar being required to pass from one to the other of plugs fitted to the head and foot-stock spindles, these being previously tested for alignment with the shears.

Center holes in all live spindles are bored upon a certain standard lathe bed to which the heads are fastened, using a taper attachment and reaming with a standard reamer just enough to standardize the holes. The B. & S. universal grinder is used in grinding all spindle bearings and other important parts of tools, on dead centers, and the phosphor bronze boxes are also ground on this machine outside and in. This box consists of a plain sleeve which is in two parts and is cylindrical outside and inside. After being turned approximately a box is put within a shell chuck which is fitted to the spindle of the grinder, this chuck being of steel and with numerous longitudinal splits which allow it to be closed upon the box by a ring. In this the inside of the box is ground true, after which the outside is ground by placing the two parts together upon a standard arbor and holding them by means of collars which are screwed up against the ends of the box, which ends are slightly beveled and the collars made to suit this bevel, so that as they are screwed up they tend to close the box upon the arbor and hold it securely enough for a grinding operation without the least possibility of springing it out of true. The collars are, of course, somewhat smaller in diameter than the outside of the box, so that there is no obstruction to the grinding.

The Woodruff system of keying, which

was referred to by our correspondent "Chip" some time ago, is in use here, and is giving the best of satisfaction. This system seems adapted to relieve the machinist of what often is a source of considerable annoyance. In this shop all keying is in charge of one man who is responsible for it. A chart in the drafting room gives the size and designating number of key to use in any given place, and it is only necessary to indicate this on the drawing, and all the key man has to do is to select the proper cutter and drop it into the designated place. The keys then fit without filing, and no springing of spindles can result from their being too tightly fitted endwise. Uniformly good results are secured—so good in fact that Superintendent Norton told me it was one of the most satisfactory things about the shop, and that if their business was very much smaller it would still pay to use the system. The milling machine which is adapted for cutting the keyseats, and is largely special in character, can, however, be used for other small jobs of milling, such as short splines, slots, etc.

Cross-feed and other similar traversing screws are, after being turned, roughed out with a die, which, running over them twice cuts the thread nearly to a finish, so near that a very little work in the lathe afterwards finishes it, the pitch being taken care of by the fact that the die is used on the spindle of an engine lathe and the blank fed forward by the lead-screw. Lead-screws are cut on a lathe devoted to this, which has a precision screw made by Pratt & Whitney. This screw is not used directly for cutting lead-screws, except those which are used in this one lathe, and which are in turn used for producing the lead-screws which are furnished with the lathes sent out, and which may thus be practically accurate.

Change gears and other standard work of like character are milled to size by a Pratt & Whitney circular milling machine, which may perhaps be more properly called a milling lathe since it does the work usually done on the lathe, and in much the same manner, except that milling cutters are used instead of lathe tools. The work of these machines has been alluded to before in these columns, and it is really remarkable in efficiency where there is enough work of one kind to justify its use. F. J. M.

A Patent Decision.

Some points of general interest to those who have to do with patents are well stated in a decision which has been recently given in the U. S. Circuit Court of Appeals for the Sixth District. The contest was in reality between the Stilwell & Bierce Company on the one hand and the Hoppes Mfg. Co. on the other, though a user of the Hoppes feed water purifier was the party originally sued by the first named company. In the shortest and plainest terms the case may be stated thus: It had been found that in using a feed-water purifier in which the feed water is subjected to steam at boiler pressure and temperature, or practically so, gases were formed within the purifier, which, remaining within it, interfered with its successful working. In order to remove these and keep the purifier clear of them some means had to be devised of establishing a circulation of the steam and gases within the heater and between it and some other vessel or steam space—preferably, perhaps, with the steam space in the boiler, and that in order to do this two pipes leading from the steam space in the boiler to the purifier were necessary. The Stilwell & Bierce Company obtained a patent upon this double connection to the steam space of the boiler; but their patent does not explicitly cover any second connection to anything else than the boiler; and it is evident that by connecting a pipe from the top of the purifier to any pipe from which steam is being drawn, as by a steam pump or injector, a circulation is set up within the purifier and the gases will be drawn off. Two men applied for patents on such a connection, one of these being Mr. Hoppes and the other R. B. Day. A patent was issued to Day, who assigned his patent to the Stilwell Company, which company warned users of purifiers not to infringe this Day patent, as it was claimed some of them were doing by using such a connection put in by or under the advice of Hoppes. But in an interference case tried in the Patent Office to decide whether Day or Hoppes was entitled to a patent on this connection to a steam pump or pipe, the decision was in Hoppes' favor, who received a patent, the Day patent being annulled. When this occurred the Stilwell & Bierce Company claimed that their original patent covering a connection to the boiler, also and in the nature of things, covered a connection to any part of the steam plant for the purpose of establishing such circulation. The decision is upon this point and we quote from it as follows: . . .

It has been said by counsel at the bar that theories do not control the decision in patent cases; that it is facts and results which are all important. This is true in the sense that if a man describes in his specifications a machine by which to get a certain result so that any one skilled in the art can reproduce the machine and the result, he cannot be deprived of his exclusive right in the machine by a demonstration that his theory, stated in the patent, of the causes producing the result is untrue. But a correct and certain knowledge of the principle by which the result is reached will often enable the patentee or his solicitor to cover, with general words, many different devices in which it may be applied. If he fails to use broad enough language to do so, then one of two things is true, either that he does not fully understand the true principle and the other devices are not part of his real invention, or else, knowing the principle and its possible wider application, he has chosen to limit his claim for a monopoly to one particularly described device, and has abandoned the others to the public. Whichever horn of the dilemma he chooses, the court has no power to broaden the claims. In the case at bar, therefore, even if the connection of the gas-escape pipe with the steam pump is only another and similar device for the application of the same principle which is embodied in the Stilwell patent in suit, as contended by counsel for appellee, the patentee did not cover that device in his patent, for he limited his claim and specification to a connection with the steam dome of the boiler, or some other part of the boiler, and a connection with the steam pump is not a connection with the steam dome or the steam space of the boiler. They may now appear to be equivalent, but they were not known to be such when appellee's patent was issued, and the patentee did not mention them as such in his specifications. The doctrine of equivalents, therefore, does not aid the appellee. . . .

A quotation from a previous decision on another case by Justice Bradley was given as follows:

When a claim is so explicit the courts cannot alter or enlarge it If the patentees have not claimed the whole of their invention, and the omission has been the result of inadvertance, they should have sought to correct the error by a surrender of their patent and an application for a reissue. They cannot expect the courts to wade through the history of the art and spell out what they might have claimed, but have not claimed. Since the act of 1836 the patent laws require that an applicant for a patent shall not only, by a specification in writing, fully explain his invention, but that he "shall particularly specify and point out the part, improvement or combination which he claims as his own invention or discovery." This provision was inserted in the law for the purpose of relieving the courts of the duty of ascertaining the exact invention of the patentee by inference and conjecture, derived from a laborious examination of previous inventions, and a comparison thereof with that claimed by him. This duty is now cast upon the Patent Office. There his claim is, or is supposed to be, examined, scrutinized, limited, and made to conform to what he is entitled to. If the office refuses to allow him all that he asks, he has an appeal; but the courts have no right to enlarge a patent beyond the scope of its claim as allowed by the Patent Office, or the appellate tribunal to which contested applications are referred. When the terms of a claim in a patent are clear and distinct (as they always should be) the patentee in a suit brought upon the patent is bound by it. *Merril* vs. *Yeomans*, 94 U. S. 568. He can claim nothing beyond it, but the defendant may at all times, under proper pleadings, resort to prior use and the general history of the art to assail the validity of a patent or to restrain its construction. The door is then opened to the plaintiff to resort to the same kind of evidence in rebuttal; but he can never go beyond his claim. As patents are procured *ex parte* the public is not bound by them, but the patentees are. And the latter cannot show their invention is broader than the terms of their claim; or, if broader, they must be held to have surrendered the surplus to the public.

Though the principles involved in this decision are, of course, not new, they are seldom nowadays stated with so much clearness, because supposed to be well understood by those interested.

We have noticed the case at this length because there seems to be in it much that can be not only readily understood by mechanics and others who have made no special study of patent law, but also be put into practical use by them when engaged in developing or perfecting inventions. The gist of it seems to be that while one need not necessarily understand the theory or rather the natural laws underlying an invention, in order to obtain a valid patent upon a device depending upon those laws for its working, yet in order to cover the invention broadly and fully, it is far better that the theory or laws underlying it should be well understood; for if, through not understanding this, or for any other reason, a patent is not made broad enough to cover all equivalent devices there may afterwards be no remedy. And a point to be noticed particularly is that patent attorneys frequently fail to understand the underlying principles involved in a patent, and when they do so fail the patent is liable to be of small account. There is therefore all the more necessity for the inventor himself thoroughly mastering the subject and seeing to it that the various equivalent devices are fully considered and protected.

The Designer Attempted to Establish Needless Limits—His Demands Were Disregarded and His Judgment Disrespected—Remedies.

BY JARNO.

It has often been thought necessary to establish limits both for things and for men, especially for other men. In Washington, as well as in other parts of the country, there are expensive gatherings every year to determine what shall or shall not be done. Few ideas enter so largely into our every-day life as those connected with limits. Emerson, in his essay on Fate, says, "In our first efforts to gain our wishes we come upon immovable limitations." These last years of the nineteenth century will be remembered

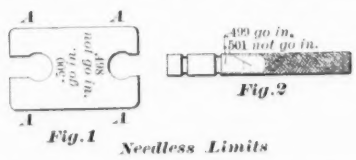


Fig. 1 Fig. 2

Needless Limits

as the age of bell punches, of cash registers, of Australian ballot, and of voting machines; in short, as the age of limits. To men wishing to escape from the confines of too close limits, it must be pleasing to dream of sitting on the roseate edge of a cloud without fear of being ordered off the glow, and of contemplating a visit to the canals of Mars, to the rings of Saturn and adjoining places.

That limits are necessary I am obliged to admit. They must be had in a machine shop that manufactures many pieces that are to fit one into another, and which cannot be tried together as they are made. Hence, limit gauges, showing the greatest variation that can be allowed in sizing pieces, are in common use. Their sizes should be established by the designer of the machine or device; he should figure the sizes upon his drawings before passing them into the workshop.

Wilbrow, a foreman inspector, criticises: "A certain machine designer annoys me and wastes valuable energy by attempting to confine the variations in sizing his work within too narrow limits. He has done this so much that whenever I hear the word 'limits' it suggests machine designer. The crossing of limits has also been attempted by machine designer, which annoys the assemblers of machines, and prevents interchangeability of parts."

Wilbrow has been asking me to tell his story in the AMERICAN MACHINIST. The present paper is the result of my fourth attempt to do so; I am surprised to note that my first attempt was about three years ago.

Fig. 1 is a common form of solid limit outside gauge, or caliper, and Fig. 2 is an inside gauge, or plug. The caliper at the large end is .500 inch, and at the small end .498; the plug is .501 and .499. A shaft or bar that is small enough to go into the .500 caliper, and large enough not to go through the .498, is passable, and holes are to be between .501 and .499.

A common thickness of the caliper, Fig. 1, is about three-sixteenths inch. When it becomes worn so as to be too large it can be brought back right by pening at *A A*. Mechanics are divided in opinion as to whether it is better to have a limit gauge solid or adjustable. Much can be said in favor of having it solid and letting only the toolmaker do the adjusting by pening.

In establishing what variations can be allowed in sizing pieces, the machine designer may determine what would be desirable, which is very indefinite; but the accuracy that is practically attainable has, after many years of experience, become quite definite. Wilbrow has to do with gauges, Fig. 1, in one of which the two sizes differ only one two-thousandth inch. Persistent effort has been directed to producing pieces that do not vary more than this amount. The nearest that has yet been attained, in manufacturing pieces by the thousand, is practically the one-thousandth of an inch variation. There was an attempt to grind three hundred bars, to vary not more than one four-thousandth inch; they came through with twice this variation. At another time and in another department the same number of bars came through with only the one four thousandth inch variation, but Wilbrow thinks this more a mechanical feat than a commercial success. Whoever performs this feat will find that the price must be high. Before me is a letter kindly written from a large sewing machine manufactory, which speaks of sizing shafts without definite limits, the attempt being to have each an accurate fit. The sizing is to be a stiff adjustable caliper set to a standard plug. A careful measurement of twenty-five shafts, from different trays, shows a variation of seven ten-thousandths inch.

Limits cross each other when the largest passable bar cannot be put into the smallest passable hole. This might occur in the use of Figs. 1 and 2. Wilbrow thinks this is very bad, as parts cannot be replaced from the factory with any degree of certainty that they can be assembled.

Goethe must have been thinking of sizing pieces when he said, "Happy is he that early learns the breadth of that chasm that separates his desires from his capacities."

Courtesy as an Incentive to Good Work.

BY GREKO.

Much has been written upon what course a young engineer had best pursue in order to become a competent and reliable man; little, however, has been said of what he actually goes through to attain this object.

In an experience of eight positions, including apprenticeship and college, I have carefully noted the results obtained from men working under the supervision of a gentleman as compared with the work turned out by men working for a bully.

Mr. Oberlin Smith, in his presidential address to the American Society of Mechanical Engineers, read a most excellent paper on "The Engineer as a Scholar and a Gentleman." If it is true, as he says, that an engineer should be a gentleman as well as a scholar, why is it any less important for the designer and draftsman to be gentlemen, or at least gentlemanly in their outward bearing toward their fellow-workmen?

McCord gives—

The engineer: the draftsman :: the draftsman: the machinist; or what is perhaps more correct:

The engineer: the designer :: the draftsman: the machinist; might we not as truly say:

The engineer: the designer:: the designer: the draftsman; then, accepting Oberlin Smith's arguments, say that just as the engineer should be courteous and gentlemanly in all his consultations, so should the designer and draftsman be courteous in their relations with each other. We must not forget that many of these men eventually become our engineers.

"Once a gentleman always a gentleman," and this is as true in the machine shop as when in dress coat and kid gloves. Is not also the converse of this true—once a bully always a bully? How then can this bully become a gentleman even though he be a scholar?

Many of the drafting rooms in our modern shops have, so far as convenience and system go, reached a state bordering on perfection. It may be that many of the men there employed are college graduates; in addition to their theoretical knowledge many have been through the shops as apprentices; some may be members of the American Society of Mechanical Engineers, learned, cultured and refined; in short, a few of them do know a good mechanism from a bad one, and can distinguish a T-slot from a hole in the ground. More likely than not, however, over that drafting room there is one of those small specimens of humanity, who, "clothed in a little brief authority," as Shakespeare puts it, has gotten the big head to such an alarming extent that he makes life miserable for all those with whom he comes in contact.

This man of authority, fearing lest a new man coming into the room shall not hold him in sufficient esteem as knowing it all, to show that he is boss and intends to remain boss; also that no man can design a mechanism quite as well as he—for, of course, all others are lacking in mechanical wisdom—this man, who, let us call Mr. Bantam Rooster, for want of a better name, will go to a draftsman to examine his drawing, and, failing to find any error in points of construction, will change the size of a fillet, put more round on a corner, and tell him that Indian ink is black. Twaddle of this kind is most common, but, of course, no machine could go together without these final touches.

When a designer, who perhaps does not at once catch Mr. Bantam Rooster's idea, asks, "Why do you do that?" the answer probably is, "Because I wish it—that's why," and then is left without a word of explanation.

When the engineer is called in to inspect the drawing of a machine which has been designed and worked up, even possibly to the idea itself, by a draftsman, it is exceedingly trying to the draftsman to have Mr. Bantam Rooster come to his table, perch himself upon his stool and say at regular intervals, as he gnaws away at his finger nails, This piece was made so for such a reason—that part I made this way—I thought I could accomplish that result so—and thus take the credit of the design to himself.

This is not the way to obtain a man's greatest worth, to promote his most active interest in the work, or to develop any genius that he may have.

A drawing should not be changed merely for the sake of making a change, when the draftsman knows as well as Mr. Bantam Rooster that the alterations are made merely as a matter of self-assertion; neither should the draftsman be called an ass simply because he calls a cheese headed screw a round-headed one as he had been accustomed to do in other places.

When a draftsman suggests a simpler and cheaper way of accomplishing a result than the one proposed, he should have the credit of it, and not be abruptly left by his boss.

I am not taking exceptional cases but every-day occurrences in the drafting rooms of some of our largest and best known firms. Let us suppose a new man has been engaged; he reports at the regular hour of beginning work, enters the room and stands waiting at the door for the head draftsman or man in charge to speak to him. Mr. Bantam Rooster takes no notice of him, and he is left to wander around the room for five, ten, twenty minutes, perhaps an hour, the object of curious eyes. This invariably takes the starch out of a man.

Finally he is given work; his instructions are to add two inches to the width of the knee of a milling machine; also to change all the corresponding parts to fit it. The job finished he takes it to Mr. Bantam Rooster and asks if it is all right. Mr. Bantam Rooster stares at the drawing for a minute and then asks if the shoe has been changed as well as the knee.

"No," replies the draftsman, "the shoe remains as it was."

"Didn't you add two inches to the knee?"

"Yes."

"Well, then, how can the shoe go on if it is not enlarged also?"

"I added two inches to the saddle, which makes it and the knee hold the same position relatively as they did before; was I not right in increasing the width of the saddle?"

"Certainly, but can't you see that the shoe must be enlarged?"

"No, I cannot."

"Whether you see it or not it is so, and you will have to make it right." With a parting snarl Mr. Bantam Rooster jumps off the stool and is away.

The new man is completely mystified; he goes over the work again carefully, studies it in every detail, and yet fails to find an error. At last he asks a rather friendly looking man near by if he can detect any reason why the pieces shown will not fit correctly.

"Do you mean the knee and shoe?" asked he.

"Yes, the saddle, shoe and knee."

"Where is your saddle?"

"That is it;" pointing out the piece.

"That piece is what we call the shoe here and this piece the packing."

"Ah! I see it all, thank you very much."

The piece that went next the knee was called the shoe instead of saddle, the taper piece to take up wear they called the packing instead of shoe or gib, as he had been accustomed to hear it termed elsewhere.

Here the lack of uniform nomenclature was the cause of this trouble, but was certainly no apology for Mr. Bantam Rooster's offensive language, which, had it been addressed to the president of the concern, would have resulted in his immediate dismissal, but to a draftsman—poor fool, he knows nothing.

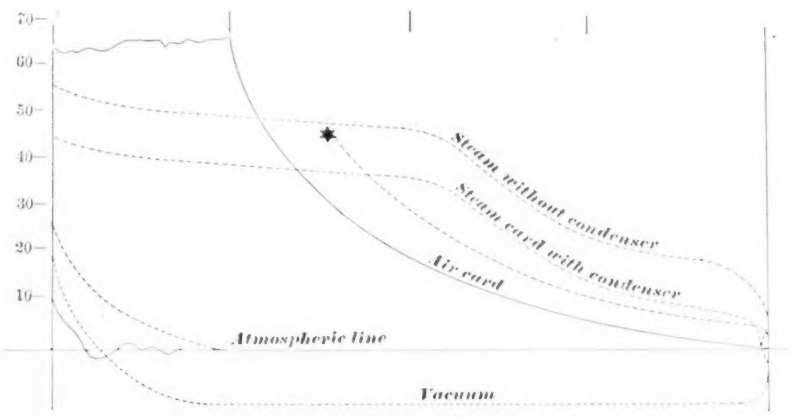
Again, a very pretty drawing of an exceedingly complicated machine has just been completed, the draftsman goes to Mr. Bantam Rooster and asks him to come and inspect the work. That afternoon and two hours of the next day go by, perhaps two days; at last he comes, pushes the man off the stool with his shoulder and sits there sucking or picking his teeth, alternately snuffing his nose and removing wax from his ears with a pencil point which he proceeds to wipe on the sleeve of his coat. Staring vacantly at the drawing he pulls an occasional hair from his scrubby beard, moustache or head, and puts it in his mouth. At other times he tears strips of paper from the edge of the drawing and chews them into spit-balls. Then as he asks the reasons for making certain pieces as they are, he points them out and marks them with a heavy pencil. His hands too are none too clean, and the result is that when he leaves, although he has made no alteration whatever in the design, the drawing requires perhaps half a day's extra work to make it even readable.

When I began this paper it was not my intention to put it quite so strongly as I have against the heads of this department, but rather to ask the question of the readers of this paper, why it is that such a man as I have depicted should ever have been placed in such a position, and if it is to the best interest of the firm, however bright and clever he may be as a draftsman, designer or engineer? Does not the manner of such a man so provoke and irritate all the men under him, both in the drawing room and shop, that it drives away all ambition, crushes their desire to do original work or make a good drawing, and tempt them to do just as little work as possible to retain their positions? Does it not also explain why some of our largest firms are constantly advertising for good men? Draftsman, as a class, are considered very migratory—is not this the direct cause?

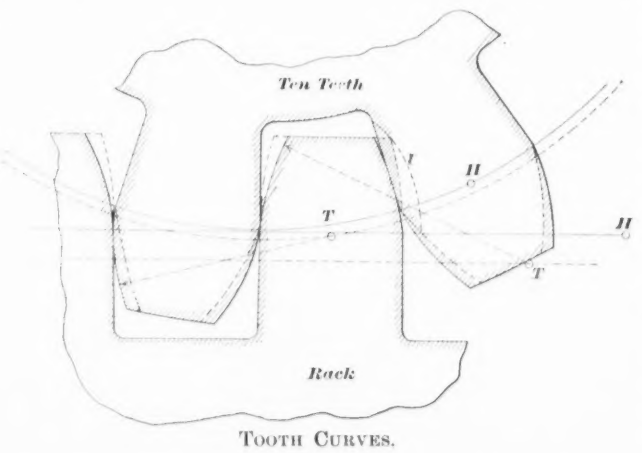
The additional cost of placing a higher-priced man in charge would be more than balanced by the extra and better class of work obtained from draftsmen treated as gentlemen than from those working under the depressing and offensive rule of a man like Mr. Bantam Rooster.

Good men are scarcer than good cheap ones. An engineer who is a gentleman keeps in touch with active men of affairs and thereby learns to do the doing. He may have no more brains than Mr. Bantam Rooster, but his polished and easy manner tends to promote the men's greatest ambition and best efforts and must be paid for accordingly.

If the slipper I have pictured fits any one I hope that it may be put on even though it pinches a little.



Air Compressor Cards.



Tooth Curves.

Standard Catalogues.

The Fox Machine Co., Grand Rapids, Mich., write us:

"We notice in the last copy of your paper an article by F. E. Reed & Co. on standard catalogues.

"The first catalogue we got out was 3¾"x6". This was some four years ago. Since then we have looked very carefully into the catalogue matter, especially regarding size, and have come to the same conclusion of Reed & Co. that a 6' x9' is the most desirable for all classes of work. It certainly would be a great convenience if the machinery manufacturers would get some standard size, as we believe, all things taken into consideration, this is the most convenient, and hope the question will be agitated until there is some uniformity brought about in the matter."

LETTERS FROM PRACTICAL MEN.

Air Compressor Cards.

Editor American Machinist:

While you are publishing air compressor cards, it may be of interest to Prof. Richards and fellow students to look at the one which I inclose herewith, and which was taken about ten years ago. The steam and air cylinders were of the same size and the speed was the same for all the cards. Steam was regulated by throttle only for the purpose of illustrating the advantages of a condenser. If cut-off valves had been used throttling would not have been necessary, as cut-off would have occurred at about the point indicated by the star on the upper steam line. The air cylinder had only a simple water jacket, therefore the air card does not represent the present advanced stage of economical air compression, though it compares very favorably with that shown by Mr. Richards, [March 9 issue] and which he calls a good one. Does there not appear to be an unfavorable peculiarity in the discharge line of Mr. Richards' card? Considering the fact that the receiver pressure was 78 pounds, the one which I inclose, and sample cards in "L' Air Comprime" (Paris, 1876), would appear to show to advantage in comparison. B.

Haswell's Rule for Drawing Tooth Curves.

Editor American Machinist:

There is no more widely known or more useful, accurate and valuable note book than Haswell's Engineers' and Mechanics' Pocket-book. It is in use everywhere and usually relied upon, and therefore a serious error in it is a proper subject for comment.

In a late, if not the latest edition, I find a rule that directs the teeth of gears to be drawn as circular arcs from centers on the pitch line and with radii set to the constant of one and-a-quarter times the circular pitch.

The figure shows a rack working with a pinion of ten teeth, drawn properly in heavy lines, and by Haswell's rule in dotted lines. The shaded portion shows the interference of Haswell's teeth, which is here at its greatest but is always dangerous.

Haswell's rule is but an example of the universal desire to take things easy, a desire sometimes called "laziness," and I may say that all the short cuts and simple rules for drawing teeth of gears, notably the well-known rule that draws an involute tooth with a radius equal to a quarter of the pitch radius, are examples of the same sin.

No such rule can possibly be correct, and for the simple reason that there is no direct relation between the pitch of a gear and the radius of the circular arc approximating to its tooth curve.

Haswell's centers, *H*, are on the pitch lines, but the true centers, *T*, are but seldom there, sometimes being outside, but usually inside of them. When the two gears of the pair are of the same size the centers *T* are always very nearly two-hundredths of the circular pitch inside of the pitch lines, but that distance will vary from ten hundredths inside to three-hundredths outside for other cases.

Haswell's describing radius is always just one and a quarter times the circular pitch, but the fact is that the true proportion is seldom just that, varying in practical cases from one-half to full three times the circular pitch, according to the numbers of teeth in the gears.

It would be very gratifying to be able to draw all gear teeth by one rule, or to cut all gear teeth with a "duplex" cutter of un-

varying form, but the fact is that neither the one or the other can be done if we insist upon a decent respect for accuracy.

George B. Grant.

Lexington, Mass.

Remarks for the Tool Shop.

Editor American Machinist:

So fast has been the advancement in the last few years in the machine tool line, that it necessarily becomes advisable to adopt the quickest methods in turning out work, and having suitable tools on hand to meet the requirements. A good deal of unnecessary expense is made in the manufacturing of machinery in disregarding the importance of the short operations, the laying out, prick-punching, drawing circles, drilling and drawing the drill, etc., over the time saving and accuracy of a jig, template or fixture, as also in the use of tools used at the lathe, planer, and drill. We rarely meet with a man who grinds his tools to take a good free cut, thereby lessening the strain both to machine and work, but will find scores of them who go up to the grindstone in the same old way, rub off the dullness without regard to shape, go back perfectly contented, start up the machine to the tune of "Grumbling Back Gears," "Hard Stock," "Hot Centers," etc., and then when the same individual goes to have a tooth extracted, he comes away declaring, "Well, don't hurt so much as it used to." No, my friend; to do the work better, in less time, with less pain to the being who holds the tooth, they have shaped, bent, and strengthened the tool to do the work.

The following are tools that no tool shop should be without: One set of standard reamers, from $\frac{1}{4}''$ to $3''$; as these wear down have the apprentice turn up a set, leaving enough to grind, and let him flute them up in the milling machine when it is not so busy, and it will be found very easy, when once the double set is made, to keep up your standard sizes. When a reamer wears out put in a new one, take the old one and anneal it, and stake it up all around, trim the teeth with a cutter, reharden it, and you have a new reamer. By this method you can keep within close limits. One set of reamer size butt mills, with Morse taper shanks, from $\frac{1}{4}''$ to $3''$, $.005''$ under size. These tools leave not only a round hole, but a straight one, and if they do not cut over $\frac{1}{16}''$ will leave sufficient to ream without telling on the reamer. For long holes these tools are indispensable.

One set of counterbores for standard round or filistered head cap-screws, with tit size of body, head size of screw head, and Morse taper shank. One set of counterbores, with tit size of bottom of tap, head diameter of screw, Morse taper shank. These tools run in one-eighth or one-quarter-inch will tend to keep the tap and screw straight. One set of counterbores, tit size of screw body, and head size of corners of hexagon cap screws; these will counterbore a seating for the heads.

One set of taps, from $\frac{3}{4}''$ to $1\frac{1}{4}''$ 16 pitch. One set of taps, from $1\frac{1}{4}''$ to $2\frac{1}{2}''$ 12 pitch; these to be used for check nuts and thrust nuts.

Short pieces made of machinery steel, such as studs, screws, nuts and washers, bushings, worms, worm gears, and a great variety of forms well proportioned, should be packed in charcoal and bone within a sealed box, and hardened by furnace, and dipping in sperm oil. It will not change their shape, diameter, or size but slightly, and if attention be given as to allowance for grinding, you have pieces that will last for years, and stand a good deal of hard usage.

One set of roughing and squaring up arbors, and one set of finishing arbors, also one set of polishing arbors. In a great many shops polishing is done on the same arbor that the work is turned on, which, owing to the high speed that is used in polishing, and the use of emery, which gets into the centers and on the arbor itself, spoils it for turning with any degree of truth. A very useful and inexpensive arrangement for polishing is made as follows: Turn up an arbor whose shank will fit the taper of the spindle of the polishing head, leaving an end extending out, with a taper $\frac{1}{8}''$ to the foot, and tapped in the end for a screw. Make a set of bushings, with diameters for all holes used, with a hole tapered to fit the end of the arbor, and length $\frac{1}{8}''$ beyond the end of an arbor. Split them, and by means of screw and washer, draw them up onto the taper, thereby expanding to fit and holding the work that is placed thereon.

In shops where standard sizes are adhered to, a set of blocks from $\frac{1}{8}''$ to $2''$ by eighths, $2''$ to $4''$ by quarters, and one $6''$ block will not only facilitate the operation of planing, but keep the sizes at a given standard by using them under a finish tool, and in the laying out of planed work in positioning heights and blocking up to parallelism. These blocks are made of cast-iron, and when once introduced and used are indispensable.

The few suggestions here made are from actual experience, where the turning out of work systematically, and not by the cut and try system, has been the aim in view, thereby keeping pace with the times as they change and revolutionize. Machinery today as it is built cannot be handled over the number of times as was formerly done to get the result, as demands are greater and supply houses more numerous, and consequently the mechanic is called upon to use his ingenuity to keep in the race and supply the demand, and at the same time make a profit and a reputation as to workmanship.

A Reader.

Water Required to Condense Steam.

Editor American Machinist:

It appears as if Mr. W. H. Booth has made a mistake somewhere in his calculations, or else he has not made his meaning plain. In the issue of March 9, page 3, he says, "The final velocity is one-fifteenth that of the exhaust, so that theoretically each pound of feed water will move 14 pounds of condensation water; allowing for loss, probably the amount of condensation water would be about 10 times the feed." Further down the column he says, "A vacuum one pound poorer, and a final temperature of 126°, would bring the amount of condensation water required to 14 times the weight of feed." From this we understand that he means that from 10 to 14 times the weight of feed water is sufficient to run a condenser. Is not this a mistake? I had always supposed that from 25 to 35 times the weight of feed water was necessary to operate a condenser properly. If this is wrong, or if I have not properly understood his meaning, will he please explain, and if his figures are correct, I should like to know what authority he has for them.

W. H. Wakeman.

[In the first reference which our correspondent makes by quotation from Mr. Booth's article, a careful reading of the paragraph will show that the latter is speaking of the quantity of water the ejector condenser will handle under the conditions named; immediately following this he shows that 21 pounds would be required. Regarding Mr. Booth's authority for the statement that 14 pounds would condense the steam, noted in the second quotation by Mr. Wakeman, Mr. Booth would find his authority in tables of the properties of steam and water, published in a dozen books. For instance, take the example as Mr. Booth puts it. We find, omitting decimals, that steam, say at atmospheric pressure, which we may assume the exhaust to be, contains 1,178 heat units per pound, and one pound of water at 126° temperature contains 126 heat units; 1,178 — 126 = 1,052. The pound of steam must then be deprived of 1,052 heat units The water of condensation will take up 126 — 50 = 76 units per pound, then $\frac{1,052}{76} = 14$ very nearly; that is, the least number of pounds of water that will condense one pound of steam under the conditions named is 14, as Mr. Booth has it. Saying that 25 to 35 pounds of water will be required to condense one pound of steam is a general expression that means little or nothing, as no account is taken in the expression of the initial or final temperature of the water of condensation.—Ed.]

Equation to the Curve for Techs.

Editor American Machinist:

I was much interested in the curve problem offered for solution in your columns by Mr. Leicester Allen, so much so, that I was led to investigate it, with the following results:

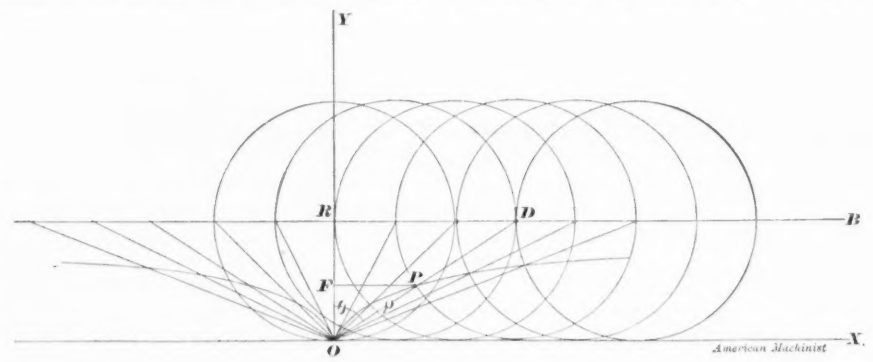
Let ρ = the radius vector of the curve, Θ = the vectorial angle, and r the radius of the circle. The polar equation of the curve is then $\rho = r \sec. \Theta - r$.

This is the simplest form of the equation of the curve. The rectangular equation is easily found. From the similar triangles $P\ O\ F$ and $R\ O\ D$ $\frac{O\ D}{O\ R} = \frac{O\ P}{O\ F}$ $O\ D = \rho + r = \sqrt{x^2 + y^2} + r$, $O\ R = r$, $O\ P = \sqrt{x^2 + y^2}$, and $O\ F = y$. Therefore

$$\frac{\sqrt{x^2 + y^2} + r}{r} = \frac{\sqrt{x^2 + y^2}}{y},$$

or, $\frac{r - y}{r} = \frac{y}{\sqrt{x^2 + y^2}}$, which reduces to

$$y^4 - 2\,r\,y^3 + x^2\,y^2 - 2\,r\,x^2\,y + r^2\,x = O$$



The equations for the lengths of the polar tangent and normal, sub-tangent and sub-normal are obtained from calculus.

Length of tangent $= \rho \sqrt{1 + \frac{d\,\Theta^2}{d\,\rho^2}} = \frac{(r \sec. \Theta - r)}{\sqrt{\text{csc.}^2\Theta - 2 \cot.^2\Theta \cos. \Theta + \cos.^2\Theta \cot.^2\Theta.}}$

Length of normal $= \sqrt{\rho^2 + \frac{d\,\rho^2}{d\,\Theta^2}} = r \sqrt{\sec.^4\Theta - 2 \sec.^2\Theta + 1.}$

Length of sub-tangent $= \rho^2 \frac{d\,\Theta}{d\,\rho} = r$ (csc. Θ + cot. Θ cos. Θ — 2 cot. Θ.)

Length of sub normal $= \frac{d\,\rho}{d\,\Theta} = r$ sec. Θ tan. Θ.

The line $R\ B$ is an asymptote to the curve, as it will only meet it at an infinite distance. There are two branches to the curve, and in tracing it from points it is only necessary to draw lines from O to points in $R\ B$, and then measure back along these lines a distance r.

This curve is a special case of the conchoid of Nicomedes, a curve found in most text-books on analytical geometry. In Wentworth's analytical geometry, the polar equation of the conchoid is given as $\rho = a \sec. \Theta \pm b$. If $a = b = r$, and the negative sign be taken, we have our identical equation.

A. L. Westcott.

Purdue University.

The Ball Problem.

Editor American Machinist:

Your reply to my question in issue of February 9th, regarding a rule whereby the correct diameter of a circle can be found, into which smaller circles fit and jointly touch each other, read and examined with interest. Previous to sending the question to you I had some plans in preparation for a machine using ball bearings, and not being familiar with a ready rule for determining an exact diameter for the inside of the cases, and the time then was pressing, so to get the necessary figures I drew carefully and accurately the cases and balls ten times the working size; that resort for the time gave me what I needed to state on drawings or for the American Machinist to know, and it proved successful in construction. Of course in drawing the said cases and balls accurately ten times the required size .01 of an inch on the enlarged drawing = .001 of an inch in the actual size. In the meantime I began in spare moments to investigate and to experiment to find out the proper mathematical calculation of any case containing balls, from 3 balls or circles to 25 inclusive; while doing so I dropped the question to you, and although we have a little different way for getting at it, we agree closely.

By the rule I used I made the necessary diameter to inclose twelve .5″ balls to be 2.432 inches; the answer you gave in February 9 was 2.43 inches. The size I gave on drawings as obtained by enlarged drawing (previously stated) was 2.44″, a difference of only .008 of an inch from the exact mathematical calculation afterwards obtained, which limit or enlargement was necessary to compensate for the variation of the size of the balls, which almost invariably are from .002 to .004 of an inch large, as obtained from the makers. As the method I used was a different one from yours, I will give it for what it is worth.

First of all I made a table of all numbers of balls from 3 to 25 inclusive, showing the degrees of each, and the length of chord at 12″ radius from the center of the circle to inclose the smaller ones. Thus each number of balls by the table has a varying form of triangle, two of the sides always being 12 inches in length; the number of degrees determining the length of chord, or perhaps, as some would say, the base line of the triangle; having thus produced a triangle it remains simply to locate the ball or circle at a proper distance from center, and to add the size of one circle or ball.

The Rule.—Find the degrees of two sides of triangle by dividing 360 by the number of circles or balls to be used.

Find in table the chord in inches of said degrees at 12 inches radius.

Multiply 12″ by the diameter of balls (*i. e.*, one of them) to be inclosed and divide by the taper or chord found in table.

Multiply the quotient by 2 and add the diameter of one ball, and the sum total will be the required diameter of circle.

Example.—What will be the diameter of circle inclosing twelve $\frac{1}{2}''$ balls?

$360 \div 12 = 30$ deg.;

the length of the chord as per table is 6.248″.

$12'' \times .5'' = 6.000'' \div 6.248''$

$= .9615'' \times 2 = 1.923'' + .5'' = 2.423''$.

Example.—What will be the diameter of circle inclosing 24 balls 3″ diameter each?

$360 \div 24 = 15$ deg.

Chord as per table 3.125″.

$12'' \times 3'' = 36''$.

$36'' \div 3.125'' = 11.52''$.

$11.52 \times 2 = 23.04 + 3'' = 26.04''$.—Ans.

Francis W. Clough.

Springfield, Mass.

[The above is a close approximation.—Ed.]

The Michigan Agricultural College.

Editor American Machinist:

It is very evident that the American Machinist is read by a large number of young men that are working in the shop and trying to do some studying in the evening. This is shown from the fact that since your answer to some one's inquiry about a place where a young man might pursue a course in mechanical engineering, and obtain work at the same time, there has come to me very many letters asking about our methods here. It appears that most of the young men have obtained wrong ideas from your reply, and perhaps you have not yourself an entirely

correct understanding of the matter. It will perhaps be well to make the following statement:

The "Michigan Agricultural College" was organized in 1855, and has been known by that name ever since.

The Morrill Endowment Act of 1862 was accepted by the State in 1863.

In 1885 the State appropriated money for the erection of a mechanical laboratory, and instruction was soon offered in the "mechanic arts." The first class graduated from this department in 1889. The growth of the department has been steady, and there are now 121 students taking the mechanical course here. Instruction is given in our "wood shop" for 36 weeks, or one college year; in the "forge shop," 12 weeks; in the "machine shop," 72 weeks; in the testing room, 24 weeks. All of this labor we regard as educational, and for it the student does not receive any pay.

In the agricultural department, part of the labor required is of such a nature as to be of value to that department, and for this the student receives a small compensation. Some of the mechanical students work for the agricultural department, and are then able to earn some money. The time of our students is pretty well filled up with required labor and studies, so that it is by no means easy to earn much money while at work on the regular duties of the term. The charge for tuition is, however, only nominal, being but $5 a term for residents out of the State. There are three terms in each year. Board in the clubs is obtained at from $2.30 to $2.70 a week. Some men have been able to earn enough to pay their board. We hope to build an addition to our shop, to be used as a foundry; when this is done we shall have a fairly well-equipped mechanical laboratory. Those wishing for further information should send for catalogue to "Michigan Agricultural College," Agricultural College P. O., Ingham Co., Mich.

We are situated three miles from Lansing, and have a post-office on the grounds, so that the above address is sufficient.

L. P. Breckenridge.

Spiral or Helical Springs—Making Patented Inventions.

Editor American Machinist:

As your paper is usually precise in its statements, I would like to inquire why sometimes the illustrations seem to disagree with their explanations. For instance, the issue of March 2d opens with an illustrated description of a gas engine; mention is twice made of spiral springs in connection with the valves, but referring to the cut, it is evident that helical, not spiral, springs are used. There are a large number of mechanics who would divide all springs into two classes—flat and spiral. The terms defined by "Haswell" are these: "Helix, a line generated by progressive rotation of a point around an axis and equidistant from its center." "Spirals, lines generated by the progressive rotation of a point around a fixed axis." "A plane spiral is when the point rotates around a central point" in same plane. "A conical spiral is when the point rotates around an axis at a progressing distance from its center, as around a cone."

As I understand the above, if I take a straight arbor (*i. e.*, not tapered to any material extent), and wind wire upon it from end to end, allowing each coil or convolution to touch upon the arbor, I shall produce a helix, and if my wire be of the proper material, it will be a helical spring. But if I wind the wire upon itself, letting each coil rest upon the one next preceding (underneath) it, increasing in diameter, not length, I produce a spiral—a watch-spring for instance.

Another very common error among our fellow-craftsmen is the prevalence of the opinion that any person has the right and privilege of making for his own individual use any patented article whatsoever he will, provided he does not sell, rent, or give it away, or use it for purposes of profit, as in manufacturing, etc.

Perhaps the editor will state his opinion or knowledge concerning this point.

Edward Shepard.

[We have referred the last part of the foregoing communication to a well-known patent attorney, who replies as follows:]

It seems to be quite well established that one may, for purposes of experiment alone, make a patented machine without liability for infringement. The main reason for this immunity, as stated in the text books, is that the patentee by such manufacture can be deprived of nothing whatever.

It very frequently occurs that a party sued for infringement makes the patented machine for the purpose of demonstrating that the machine as patented will not operate, and, therefore, the patent is invalid, or that it operates upon principles entirely different from the supposed infringing device, and, therefore, there is no infringement. Without the right to make the machine these defenses could not be established in many cases, and it seems that such making could not be held as infringements.

Cross-ruled Paper—Sketches.

Editor American Machinist:

For the information of your correspondent, Mr. C. G. Sauls, who writes in your issue of March 23d, regarding cross ruled paper, etc., I will say that ever since I first established the system of using it for all scale drawings in 1865 or 1866, I have had a regular series of sizes, the larger sheets multiples of the smaller ones, so that the paper would not be cut to waste, and so that drawers for holding the various sheets could be systematically divided up by partitions.

If Mr. Sauls will refer to a paper of mine, read before the American Society of Mechanical Engineers, and published in the American Machinist of November 25, 1882, page 4, he will find a full description of the system for making, keeping and indexing these various sizes of drawings, wherein the largest sheets are 24″x36′, followed in sequence by 18″x24′, 12″x18″, 9″x12″, 6″x9″, and 4½″x6″, the sheets of these respective sizes being named F, E, D, C, B and A respectively. Another discussion of this matter will be found in Volume VIII. of the Society's Transactions, page 301.

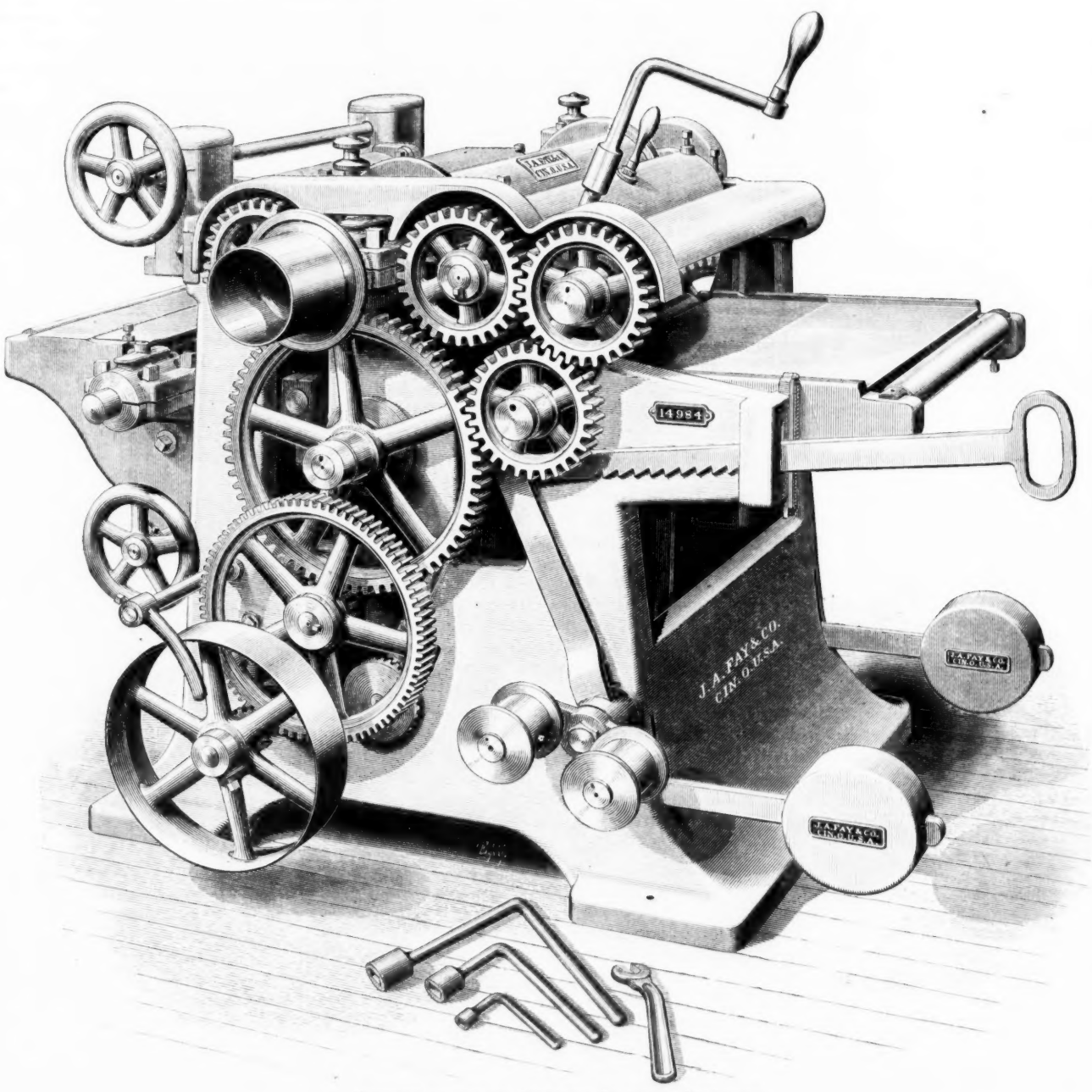
In regard to making *all* preliminary sketches upon cross-ruled paper, I do not find that this is invariably best, although I almost always use it for scale drawings. In some instances a sketch must be *very* free-hand indeed, and it is impossible to keep it approximately to scale. In such case as this the cross-ruled lines are apt to cause some confusion, as the reader of the sketch is apt to consider it drawn to scale when it really is not—nor anywhere near it. A scale drawing, on the other hand, is bound not to tell a lie, if it agrees with the ruled lines.

Oberlin Smith.

Double-cylinder Surface Planing Machine.

The machine which we illustrate herewith has been designed to meet the requirements of those who wish to plane, with a machine of medium weight, two sides of lumber simultaneously, producing very smooth surfaces.

It is a heavy, compact, and durable machine, with all the essential qualities of a perfect surfacer, and for use in planing-mills, sash, door and blind factories, furniture and cabinet shops, carriage, wagon and agricultural implement works it will prove very efficient. It will plane both sides of material 26″ wide and under, and the bed lowers to receive material 6″ in thickness.



Double-cylinder Surface Planing Machine

The frame is very heavy with plate sides and ends, and with wide and firm base. The cylinders are made of solid forged steel, with long journals 1⅞″ in diameter. The upper one is supplied with a pulley at each end for using two belts, and receiving ample driving power. Each cylinder carries two knives. The lower cylinder has a vertical adjustment operated by hand-wheel shown.

The feed rolls are four in number, of large diameter, and connected by very heavy gearing, producing a powerful and positive feed. The feeding rolls are provided with adjustable weights for varying pressure, while the delivery rolls have spring pressure. They are encased to protect them from dust and shavings.

Two rates of feed are usually provided for—21 and 36 feet per minute—and the feed is started and stopped by means of lever and belt tightener acting on the slack side of the belt.

The pressure bars on each side of the upper cylinder are self-acting. The one in front rises and falls with the feeding in roller, and always retains the same relative position, yet allowing it to yield to any inequalities in the surface of the material. The bar controlling the pressure after the cut is adjustable, and short pieces can be planed without clipping. The bar after the cut of the lower cylinder is adjustable to meet the cut being taken.

The bed is heavy and gibbed to the frame, with provision for taking up the wear. It may be quickly raised or lowered to suit different thicknesses of lumber, and marked by index and scale.

The makers are J. A. Fay & Co., Cincinnati, Ohio.

Messrs. Watson & Stillman write us:

"In August 18, '92, we believe you printed an article on 'Spiral Springs,' by J. Begtrup. We wish you would mail us a copy of the paper, as the copy which we had here has been destroyed in trying to keep it, and the table has proven in our shop a very reliable one."

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The Ann Arbor Case.

It is becoming apparent, as the discussion of the Ann Arbor troubles goes on, that the time is coming when the fact that the public is in most cases vitally interested in the operation of railroads will have its effect upon legislation, and upon the interpretation of common law bearing upon the relations of railroad employes to the companies employing them. As things are now arranged, merchants and manufacturers who may believe that the men have the right side of a dispute about wages or other conditions of employment, and whose sympathies are entirely with the men in the matter, may be more injured in business by a strike than the company. A strike is nothing else than a form of war, and in all wars non-combatants are more or less affected, usually injuriously. While this feature of the business has been very much regretted, and many plans have been suggested to get around the difficulty, no way of doing it has been suggested that seemed practicable, and the evil, recognized by both companies and men, has grown until it is well nigh unbearable, and something must be done. What that something will be it is hard to say, but that many of the peculiar conditions involved in the case are not recognized or understood by those who are discussing the matter is quite evident.

Judge Ricks, in speaking of the right of railroad men to quit work, says, "You cannot always choose your own time and place for terminating the relations. If you were permitted to do so, you might quit your work at a time and under circumstances which would involve irreparable damage to your employer, and jeopardize the lives of the traveling public." Now so far as jeopardizing the lives of the traveling public is concerned, it is evident that this point has much force, but as to the irreparable injury feature of the case: let us see how the ordinary machine shop proprietor protects himself in this respect when dealing with other individuals.

Castings are usually a necessity in a machine shop, and sometimes it happens that a failure to furnish certain expected castings at the time expected works irreparable injury to the machine shop. The proprietor protects himself so far as possible against this by having a contract with the foundrymen to deliver the castings according to specifications. In the absence of any such contract, he knows that the foundryman cannot be held responsible for irreparable or any other kind of injury which may result from a failure to deliver, and the contract when made is binding upon both the machinist and the foundryman. That is to say, if the foundryman is bound by the contract to furnish certain castings at certain times within a given period, the machinist is also bound to accept them at such times, and for the given period. It would not be a legal or an enforceable contract unless it applied equally to both parties. Applying this principle to the engineers and the railroad companies, it would seem that if the men cannot quit when they like, neither can the companies discharge them when they like. Chief Arthur says the men will be willing to agree to anything in this regard, which is to be made equally binding upon the company; he might have added that nothing else will in the end probably be required by the courts, nor by any other authority.

But if employment on railroads is made semi-military, as some propose, there will still be difficulties in the way. Suppose, for instance, that orders come from Wall street to reduce wages, or to reduce the working force and make the remainder do all the work. The men refuse to accept the new conditions, and give notice that they will quit as soon as the legal limit of time has passed. Then during this time the company will, of course, be gathering up new men to take the place of those who are to quit. The new men must receive some instruction, and be given some opportunity to become acquainted with their new duties previous to assuming them. Who is to give this instruction, and how is it to be given, so long as the old men remain in their places? There is no doubt, however, that under such an arrangement the roads would have decidedly the advantage, and where is the public's assurance that the net result will not be a very material lowering of the personnel of railroad service? The public is vitally interested in having efficient men employed on railroads; security of life and limb depends largely upon this, and always will. Much of the trouble with employes has been caused by dictation from Wall street—orders given there which the railroad officials knew to be wrong, and calculated to bring on trouble. If the public's rights are to be protected, this also must be looked into. It is to be remembered that railroad officials and stockowners are also human, and that it is absurd to suggest that men entering the employ of a railroad shall be sworn to do various things, among them to abide by and enforce the rules made by a railroad company, so long as those rules may be anything that may be dictated by the cupidity or ignorance of a Wall street operator or his official tool.

If the public through its courts or legislatures is to interfere in this matter to protect itself, it must go about it thoroughly, and see that every regulation imposed bears equally upon all concerned, including the Wall street owners of railroads, who know practically nothing about managing them, and usually have little interest in either the roads, the employes, or the rights of the public. The government may make laws controlling railroad employes especially, but these laws must bear equally upon all, or they will not be sustained by the people; nor will the people sanction any delegation of the law-making power of the government to irresponsible railroad officials.

"Let us consider the reason of the case. For nothing is law that is not reason."

World's Fair Matters.

The *Iron Trade Review* says that we have been disposed from the first to criticise the Chicago Exposition management on the ground that space in Machinery Hall was not assigned with proper discrimination. We think this is a mistake. Long before the space in Machinery Hall or elsewhere had been assigned, and before any one could know certainly whether it would be assigned with proper discrimination or not, we saw a copy of a letter from Chief Robinson, in which he said that the space applied for in Machinery Hall would probably far exceed the amount of space available, and that applications would be cut down pro rata. We simply pointed out the error of this plan of assignment, on the ground that some manufacturers were designedly applying for much more space than they required with the expectation of being cut down; while others, and among them many of the best representatives of American machinery interests, were applying for no more space than they actually needed to properly display their products. We said that some discrimination should be made between these, and that space should be assigned only after a careful examination of the actual necessities in each case. We have no means of knowing whether or not our suggestion was acted upon in the matter, but at any rate, the space was not cut down pro rata, or, at least, if a pro rata reduction was made the basis of assignment, there were sufficient exceptions to the rule to show that other considerations had been weighed.

As to our former remarks upon the subject of the charge that New York manufacturers and merchants had formed a conspiracy against the Fair, we should like to inquire how those who advance this theory account for the action of some prominent Philadelphia concerns. Philadelphia was not an applicant for the Fair, the fact that the Centennial Exposition was held there barring her, even if she had desired it. During a recent visit to Philadelphia, we found that both William Sellers & Co. and Bement, Miles & Co. have abandoned their intention of making an exhibit at Chicago. Any one who is at all posted on machine tools can form his own opinion as to the gap made in this country's exhibit of machine tools by the withdrawal of these two concerns. It is sufficient for us to say that the gap is a very large one indeed. The first named firm had 4,500 square feet of space at the Centennial, and applied for 9,000 at Chicago, an increase which probably does not by any means fairly represent the growth of their business, and the increase in varieties of tools built since '76. They were reduced to 3,000 feet. This reduction is not the only reason for their withdrawal, but it shows simply that, granting that the amount of space available has been assigned with the best possible judgment, too much reduction has been necessary, and that, in planning for the machinery exhibit, there has been a failure to understand the tremendous growth of machinery interests in this country since the Centennial. Chief Robinson of the machinery department has his home in Philadelphia, which fact, if it have any influence, ought to conduce to a full representation from that city.

We do not, of course, wish to be understood as saying that the Fair, either in its machinery features, or in any other respect, is going to be a failure; we think it will be a great success; but the American Machinist belongs to the country, and not to New York, to Chicago, nor any other city. We are interested in the success of Fair, and should have been no matter where it might have been held, because it is an American exposition. We believe it will succeed, but we hope its officials will have good and sufficient explanations of all charges that may be brought against them by dissatisfied exhibitors or others, and not find it necessary to charge conspiracies, with jealousy as their foundation.

If we might make a suggestion to those who are introducing new devices to save coal, we would advise them when trying to impress upon owners of steam plants the importance of adopting the improvement, not to attempt it by statements as to the world's coal bills in the aggregate. A statement, for instance, to the effect that the world pays annually $500,000,000, or any other large sum, for coal, is neither here nor there, and is apt to be far less impressive to a manufacturer than to demonstrate to him how much his particular share of this expense can be cut down. There are people who are so constituted that when confronted by magnificent figures of this kind they lose their heads to some extent, and conclude that it is very important for them to cut the bill down somewhat, but manufacturers are not usually impressed very strongly in this way.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(158) F. D., ——, writes: I wish you would explain to me some way to figure the amount of stock necessary to cut a full thread. Please give figures for ¼″ pitch. *A.*—For a V-thread 1.733 divided by the number of threads per inch will give double the depth of the thread or the amount of stock necessary for a full thread. For a U. S. standard thread divide 1.3 by the number of threads per inch. Thus for a V-thread of ¼″ pitch the amount of stock will be $\frac{1.733}{4} = .433''$, and for a U. S. standard thread $\frac{1.3}{4} = .325''$.

(159) M. F. L., Tremont, Pa., writes: Three car wheels are attached to one straight axle, one 6-foot wheel at each end and a 3-foot wheel in the middle, the three wheels resting on three parallel rails, the rails for the larger wheels being on a level, and the middle rail elevated 18 inches. The friction

on the three rails being uniform, will the three wheels travel together on the three rails without slipping? M. says they won't. P. says they will. Who is right? Please explain. *A.*—Under the conditions named, the small wheel will slip on its track a distance equal to the difference between its circumference and that of the larger wheels.

(160) M. W., Creston, Ia., writes: Please inform me how to build an oil engine. I want to make one about 4 horse-power for my own use at home. A friend of mine saw an account of Richards' oil engine some time ago, but has forgotten what it was like. I should like to have detail drawings of it. *A.*—Richards' oil engine was illustrated and described in our issue of September 10, 1887. We do not know where you can obtain detail drawings; in fact, if you had them you could not build the machine for your own use, as the machine is patented. If you desire to build such a machine, you will probably have to make your own designs, and avoid infringing on other patents.

(161) J. A. C., Grand Forks, N. Dakota, writes: Please inform me how to get a machine patented. *A.*—We see no other way than to engage the services of a reliable patent attorney. 2. Please give me the name of some book that will give practical information on the steam engines, pumps and boilers, which does not confuse one's mind with algebra or such things. *A.*—Algebra does not confuse any one's mind, but on the contrary, it frequently helps the student to gain a clearer idea of subjects treated on. All the knowledge of algebra necessary to follow some of the elementary works is easily acquired, and we should advise you to study the elementary principles of algebra. "Elementary Manual on Steam and Steam Engine," by Professor A. Jamieson, "Practical Treatise on High-pressure Steam Boilers," by W. M. Barr, and "Pumping Machinery" by the same author, are good books.

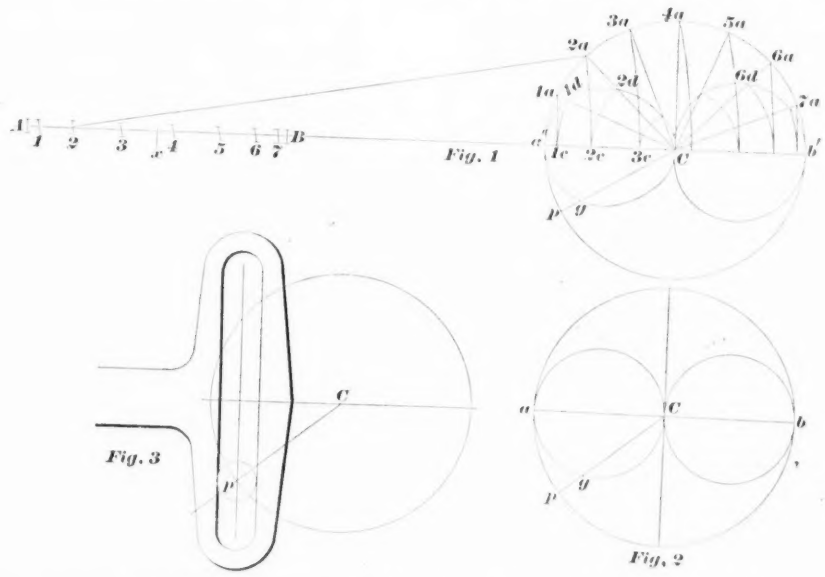
(162) J. H. B., Kingston, Canada, writes: I have a boiler 12 feet long, 48 inches diameter, with 70 3-inch tubes. The boiler is set in brick in the usual way. The grate surface is, I think, 14 square feet; the boiler carries a steam pressure of 60 pounds What is the largest cylinder of an engine that the boiler will supply? The engine is to run at the rate of 80 revolutions per minute. *A.*—The size of cylinder will depend much on the type of engine, and the care with which it has been built, and also on the steaming capacity of the boiler. From this it will be seen that the size of cylinder cannot be given with any great degree of accuracy; a rough approximation points to a cylinder 15 inches diameter and 24 inches stroke for an automatic cut-off engine of good construction. 2. The chimney is 60 feet high, what should be its diameter? *A.*—For a grate surface of 14 square feet and burning 15 pounds of coal per square foot of grate surface per hour, the diameter of chimney should be 23 inches. 3. What power can I get out of this boiler? *A.*—See answer to Question 97 in our issue of March 2, current volume. 4. Did you illustrate the Johnston compound locomotive? *A.*—No.

(163) D. B. C., Kanopolis, Kansas, asks: Will a boiler compound which eats a hard scale off the sheets eat the iron also? *A.*—We have no faith in boiler compounds unless we know what they are made of; a compound that may act beneficially in one kind of boiler, and with a certain water, may prove actually dangerous when used under different conditions of boiler arrangement and water. 2. We are troubled with alkali and salt in our feed water, which causes a heavy scale to form on the boiler sheets. Now I would like to know the best way to remove the scale, and prevent it from forming. There are two ways we could do this; first, by using a live steam purifier, and removing what little scale may be formed when necessary; second, by using compounds. Which in your opinion is the best method? *A.*—We should use a live steam purifier of good construction. For removing the present scale we should try kerosene; the manner of using it, and the quantity required is given in our issue of December 17, 1887. 3. How would you test a steam boiler to ascertain its safety? *A.*—See answer to Question 85, in our issue February 23, current volume.

(164) J. T., Walton, N. Y., writes: Kindly inform me if the Kennedy spiral punches and dies can be procured to fit other punching machines, and if so, where? *A.*—You can have these made to fit any machine; write to dealers in machinists' tools and supplies. 2. Is the punch illustrated in your issue of March 25, 1882, and made by R. E. Dietz, still on the market? *A.*—Yes; write to R. E. Dietz, 429 Greenwich street, New York. 3. Is it possible to get a copy of the first volume of the AMERICAN MACHINIST? *A.*—Our stock of Volume I is exhausted; we do not know where you could procure a copy. 4. I am desirous of being able to design a machine and proportion its parts, or to take a machine and design larger or smaller sizes, and get the proportions correct. Can you inform me of any book that has the necessary data to work from, or any book that would help me? *A.*—For general work of designing, "Mechanics of Engineering," by J. Weisbach; "Elements of Machine Design," by W. C. Unwin, and "Elements of Machine Design," by J. F. Klein, are good books, and may help you. You will probably need quite a number of other books, including text-books; in fact, to become a good designer you will need quite a library.

(165) C. W. G., ——, writes: In your reply to Question 496, in your issue of November 17, 1892, you say that gears 80 on the stud and 20 on the lead-screw will give $1\frac{1}{4}$ threads per inch, also 160 on stud and 41 on screw will give $1\frac{9}{328}$ per inch. Have you not made a mistake? I am not a machinist, and have not the opportunity to investigate, but consider that I am a competent computer of gearing. I should say for $1\frac{9}{328}$ threads per inch, gears of 205 on stud and 32 on screw will be required, and for $1\frac{1}{4}$ threads per inch 125 on stud and 20 on screw. *A.*—Our answer is correct, and we do not see how you can obtain the results you mention, unless you take the term "threads per inch" to mean "pitch," which is not correct. The following rule is applicable to all simple geared lathes: The product obtained by multiplying the number of threads per inch to be cut by the number of teeth of the wheel on the stud is equal to the product of the number of threads per inch on the lead-screw into the number of teeth of the wheel on this screw. To express this rule in symbols: Let N be the number of threads per inch to be cut, W the number of teeth of the wheel on the stud, n the number of threads on the lead-screw, and w the number of teeth of the wheel on this screw; we then have:

$$N \times W = n \times w.$$



(166) E. B., Ethel, La., asks: What would be the advantage gained, or would there be any, by forcing the feed water through a heater pipe about 7 feet long by $1\frac{1}{4}$ inches diameter in the exhaust cavity, under the following conditions: I force direct to boiler now, and use about 6 feet of pipe only between inspirator and boiler, whereas if I use a heater I would have to use about 22 feet of pipe. Would an inspirator work satisfactorily under the last-named conditions? *A.*—This extra length of pipe will not interfere with the working of the inspirator; but you will not gain an advantage to pay for the trouble of adding this short extra length of pipe 2. I use a 10 horse-power engine and boiler. Last fall I ginned 420 bales of cotton, and used 130 cords of pine wood. In the fall of 1891 I ginned 604 bales of cotton with 120 cords of wood, using a 6 horse-power engine, and carried a boiler pressure of 85 to 90 pounds. With the 10 horse-power engine doing the same work per day, we had a boiler pressure from 60 to 65 pounds of steam. The engines were both the same distance from the boiler, and jacketed about the same, and the power transmitted from both was just the same. How can you account for the larger engine using so much more fuel than the small one? *A.*—This is probably due to the higher steam pressure used in the small engine; the steam was very likely cut off sooner than in the larger engine, and advantage taken of the expansion of steam. The general design of engine may also have considerable to do with the difference of fuel; indicator cards would probably show defects in the larger engine. The 10 horse-power engine is evidently too large for the work it has to do. 3. I exhaust into the smoke-stack so as to obtain more draught, but I find it is almost too much. What advantage would there be by regulating the draught by the draught door on front of boiler? I would not have enough draught by taking the exhaust out of the stack. *A.*—You can regulate the draught by the ash-pit doors, but we believe a better way will be to put a damper in the uptake of the chimney, or by dividing the exhaust so that a part only will pass through the stack, and the remainder exhausted outside of stack.

(167) R. O. W., Balsam, Canada, writes: Kindly give me a simple rule for finding the position of piston from the center of its stroke for a corresponding position of crank, the axis of cylinder and center of crank-shaft being in line. *A.*—Draw the straight line A b, from any point C on this line as a center, and with a radius equal to the length of the crank, describe the crank circle a 4 a b; this circle will represent the path of the center of the crank-pin, and C the center of the crank-shaft. Make A a also B b equal to the length of the connecting rod; then the points A and B will represent the center of crosshead pin at the ends of the stroke, and the points a and b will be the dead centers of the crank-pin. Let C 2 a be any position of the crank, it is required to find the corresponding position of the piston. From the point 2 a in the crank circle as a center, and with a radius equal to the length of the connecting rod, describe an arc cutting A B in point 2, the distance from A to 2 will be the distance from the end of the stroke to the piston corresponding to the crank position C 2 a; x is the center of the stroke; hence the distance from 2 to x will be the distance from the center of the stroke to the piston. If we now make C 2 d on the crank center line C 2 a equal to 2 x we obtain the point 2 d, and will have no further use for the construction on A B, as the distance C 2 d will always show us the position of piston from the center of the stroke corresponding to the crank position C 2 a. If we now draw other radial lines for the crank positions, and on each lay off the position of piston from the center of stroke, and through the points, such as 1 d, 2 d, etc., draw a curve, we may then readily find the position of piston corresponding to any position whatever of the crank. Summarizing the whole construction we have the following: On the crank circle lay off any number of points, the more the better, such as 1 a, 2 a, 3 a, etc., and through these points draw the radial lines to C. From the points 1 a, 2 a, 3 a, etc., as centers, and with the length of the connecting rod as a radius, draw a number of arcs cutting A B in the points 1, 2, 3, etc.; from the latter points as centers, and again with the length of the connecting rod as a radius, draw a number of arcs, which will pass through the points 1 a, 2 a, 3 a, etc., and cut a b in the points 1 c, 2 c, 3 c, etc. From C as a center draw an arc through 1 c, cutting the crank position C 1 a in the point 1 d; again from C as a center draw an arc through 2 c, cutting the crank position C 2 a in the point 2 d, and so on. Through the points 1 d, 2 d, etc., as found above, draw the curves a 2 d C and C 6 d b. These curves will enable us to find the position of piston for any position of crank very readily. Thus let C p be any crank position, cutting the curve in the point q; then C q will be the distance from the center of stroke to the piston. Of course, the crank circle and length of connecting rod must be drawn with the same scale. After we have found the curves a 2 d C and C 6 d B, we may erase the construction on the left of the crank circle, as we have no further use for it. If the connecting rod is considered to be of infinite length, or if the crank-pin works in a slot cut into a yoke forged to the piston-rod as shown in Fig. 3, then the construction becomes very simple. In cases of this kind we have to draw only the crank circle as shown in Fig. 2, and on its diameter a b draw two smaller circles whose diameters are equal to radius of the large circle; in short, the curves shown in Fig. 1 become circles as shown in Fig. 2. If in the latter we draw any crank position as C p, then C q will be the corresponding position of the piston from the center of its stroke. 2. Are engineers of tugboats required to have a government license to run on the lakes, bays and rivers in the United States and Canada? *A.*—Engineers on all steamers, large or small, navigating the waters of the United States must have a license issued by the Board of Supervising Inspectors of Steam Vessels.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant Gears. Lexington and Phila. See page 11.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N. Y.

Forming Lathes Mer. Mach Tool Co., Meriden, Ct.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Drill Presses, with Tapping Attachments.
Gould & Eberhardt, Newark, N. J.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Engine Castings, Humphrey's Foundry, Bellefontaine, O.

For Cypress Tanks and Vats, address W. E. Caldwell Co., Floyd and Main Streets, Louisville, Ky.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

"Shapers (Double Triple Quick Stroke")
Trade Mark.
Gould & Eberhardt Newark, N. J.

For the Latest Improved Diamond Prospecting Drill, address the M C. Bullock Mfg. Co., corner Canal and Washington Sts., Chicago, Ill.

Combination, duplex and special gear cutters in stock and to order, vertical milling machines. R. M. Clough, Tolland, Conn.

Gear Cutters, Auto. Specially adapted for Motor Gears and all other style Gears.
Gould & Eberhardt, Newark, N. J.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

Sidney, Ohio, offers cash inducements to manufacturers to locate. Iron manufactories preferred. Correspondence with responsible parties solicited. J. K. Cummins, Secretary Improvement Board.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles – the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Notes.

BY P. H. BULLOCK.

SPECIAL SCREW THREADS.

There is before me a cam and its set screw, the latter stripped. They are parts of a small machine, on the shaft of which there are several other cams that produce certain definite and unadjustable motions, and these are all pinned to the shaft securely; but the one under discussion has to be frequently moved to suit varying sizes of work, and is intended to be held by the set-screw. It is a set screw pure and simple, and has no other function in the economy of the machine except to hold that cam. The only peculiarities about it are that its head is ornamented; thus, C 37, and that it has 30 threads to the inch, and is $\frac{23}{64}$" in diameter. The threads are useful in a limited degree for advancing the screw; the ornamentation for identification, and in a major degree for advancing the profits of the makers of the machine, for the catalogue also before me proves the identity of the fact by an excellent cut, and the following text: "Part C 37; set-screw to cam C 36, 24 cents." Now it is of no use to go anywhere else for that set-screw, for no sane hardware dealer keeps set screws $1x\frac{23}{64}x30$, and the only thing to do is either to wait for the part to come, or bother to make one if you have the facili-

ties. I suppose it is a matter of ethics rather than mechanics whether the makers of a machine have a right to subject their patrons to annoyance and extortion in order that their profits may be increased. If there was any good mechanical reason I would not kick at the thread, size or price, but a ⅝x16 screw costing 2 cents would be better for the place than the one adopted. Last week four cap screws were broken, and the stubs had to be got out; we found them to be ⅝x12 threads, and there were no numbers or any catalogue—we simply run up against the trouble. Now there was no occasion for this latter deviation from the standard any more than in the former case, and every one knows that a full 12-thread very much weakens a ⅝ bolt. These cases are a little more exasperating than the varying standards in ⅝ and ½-inch bolt threads, which are now generally getting settled at 11 for ⅝ and 13 for ½ inch, but in plants that have been erected for several years numerous repairs are necessary, and the old and new will get mixed much to the discomfort of the mechanic who often does not discover that he has an 11 nut on a 10-thread bolt until both are practically spoiled. I do not expect the breech blocks of rifled ordnance or lead-screws of lathes to be made to a standard and kept on sale in common hardware stores, but I do fail to see any good reason why so simple a thing as a set-screw should be anything but the standard size and thread.

SPEED OF MACHINERY.

There can be no doubt but what there is a certain speed at which any machine will do the best work, but there are cases where there is a wide limit in which they will do fairly well. I have in mind a meat chopper that came provided with cranks to be operated by men, but as it was convenient to use power I put on a pulley speeded at 65, thinking that would be about the limit of human endurance. The machine worked all right and without complaint from the operators for several months, when, during some changes, some pulleys got exchanged, but without my knowledge until several days after, when I was informed that the machine was working far better since I had speeded it up. Judge of my surprise to find it running 300. This was several years ago, and it is still making hash at the latter speed.

A lot of machinery was to be set up, and I asked those furnishing the same to send me the floor space required, the size of tight and loose or other driving pulleys, and the speed they should run. Our answer was as follows regarding speed: "Driven by a clutch pulley 8″ diameter 3″ face; speed 108 per minute." As the driving shaft run 250 it will be seen that the pulley for this would be little else than a large collar, which I proceeded to make for this special case. When the operator came to start the machine, he wanted to know what fool speeded the machine. I plead guilty, and flashed up the card of directions and a speed indicator to prove my work. He said it ought to go five times faster than it was apparently going, but that 108 was correct. We nearly came to personal hostilities before I found out that he wanted the machine to head 108 rivets a minute, and that he did not know anything at all about the relative speed of the clutch pulley, which, as a matter of fact, had to run 480 to produce the desired 108. A printing press also arrived with the tagged information that it should run "720 impressions per hour." This was a little more definite, yet it imposed the figuring up of fractional gearing and the reducing to revolutions per minute of the driven pulley upon the purchaser. Why not attach a tag to the driven pulley as follows:

This pulley must run —— revolutions per minute ?

"Keep's Test"—Exceptionally Strong Iron.

We have an item from a large foundry using this system of testing, but who do not give us liberty to publish any names. They say with a recent test the average strength of four ½-inch test bars one foot long was 448 pounds. The individual bars were 453, 500, 400 and 440. They think the 500-pound bar is the strongest bar of ordinary cupola iron yet reported. The mixture contained no Lake Superior pig-iron. This would correspond to a bar 1″ × 1″ × 1 foot with transverse strength of 4,000.

The settling of the labor trouble in Lancashire calls to mind the magnitude of such matters in England. It is said that 125,000 employes were directly or indirectly involved in the strike, which lasted twenty weeks. When the settlement was finally made, concessions were practically equal on both sides. If the settlement had been made in the beginning on the same compromise it would have made a difference of probably $20,000,000 or more to employers and employes.

A special appeal is being made on behalf of the United Kingdom Railway Officers and Servants' Association, of which Sir Myles Fenton, Kt., is president this year, the Prince of Wales being patron. It is mentioned that the need for such an institution is shown in the fact that during the past year 603 railway men and the servants of railway contractors were killed and 9,156 were injured in the performance of their duties on or about the various lines of railway. This is very far in excess of the accidents to persons killed and injured in all the factories and workshops in the United Kingdom.—London *Engineer*.

MANUFACTURES

Oak Park, Ill., is to have a new sash factory.

Pekin, Ill., is again making an effort to secure a canning factory.

It is expected that a canning factory is to be built at Orwell, N. Y., this season.

A stock company is being organized at Chattanooga, Tenn., to erect a cotton mill.

The Tampa (Fla.) Water-works Company will increase its capital stock to $200,000.

The erection of a creamery is contemplated at Stanley, Va. J. E. Hively is interested.

A stave and heading factory will be established at Bowling Green, Ky., by T. J. Sullivan.

Shoenberger & Co., Pittsburgh, Pa., are putting in a new train of rolls to turn out billets.

A cotton-seed oil company has been organized at Caldwell, Texas. Capital stock, $20,000.

A tobacco factory will be erected at Owensboro, Ky. Address D. H. Martin, Greenville, Ky.

The J. & J. Rogers Iron Co., Au Sable Forks, N. Y., will erect a large pulp-mill this spring.

The saw-mill, grist-mill and cotton gin will be rebuilt at Farmersville, La., by J. W. Stancil.

A company will be organized to erect a barrel, and fiber manufactory at St. Petersburg, Fla.

Several new iron furnaces will be constructed by the Roane Iron Company, Rockwood, Tenn.

Fox Machine Co., Grand Rapids, Mich., issue several leaves illustrating trimmers and shapers.

A 4,000 spindle mill for coarse yarn will be established at Anniston, Ala., by W. H. Chaddock.

A palmetto manufacturing company has been organized at Savannah, Ga. A. Minis, secretary.

A woolen-mill will be established at Martinsburg, W. Va., by the Middlesex Knitting Company.

A straw board manufactory, with a capital stock of $100,000, has applied for a location in Decatur, Ill.

The South Mill Company, of Briston, Ala., intend erecting a saw and planing-mill and cotton-gin.

The F. H. Henning Cycle Company has been incorporated at Peoria, Ill., with a capital stock of $5,000.

The Portable Electric Light and Power Co., of Peoria, Ill., has been incorporated. Capital stock, $250,000.

New machinery is being placed in the tile factory at Pontiac, Ill., and the entire plant will be remodeled.

The Lay & Sperry Manufacturing Co., of New York, has been organized to manufacture veneers. Capital, $10,000.

Wade & Waldron contemplate erecting a steam saw-mill on the farm in Warren, Maine, which they lately purchased.

A license to organize has been issued to the Havana Metal Wheel Company, at Havana, Ill. Capital stock, $15,000.

The Loeb Foundry Company, of Decatur, Ill., has let the contract for the erection of an addition to their works, to cost $15,000.

The *Courier* Printing Company has been incorporated at Taylorville, Ill. The object is to publish a newspaper. Capital stock, $3,000.

The Carnegie Company has purchased more ground at Braddock, Pa., and an extension of the Edgar Thomson steel works is expected.

The Keystone Mill, Pittsburgh, Pa., is running double turn, employing 500 men, and turning out about seventy-five tons of pipe iron daily.

The Edisto Cotton-mills will be constructed at Charleston, S. C. Capital stock, $100,000. Incorporators—Samuel Dibble, James H. Fowles and others.

The L'Anse Lumber Company, which is building a mill in L'Anse, Mich., will have a stock of 7,000,000 or 8,000,000 feet ready to saw on the opening of navigation.

The Carnegie Company, Jones & Laughlins, and the National Tube Works of McKeesport (all in the Pittsburgh, Pa., district) are running steadily, employing 20,000 men.

Taylor, Wilson & Co., 314 Duquesne Way, Pittsburgh, Pa., founders and machinists, have removed to their new works on Grant avenue near Union Bridge, Allegheny, Pa.

The Pittsburgh Wire Works, at Braddock, Pa., has put all departments in operation both day and night, doubling the force of employes, until they now number about 450.

Franklin, Ind., is to have a canning establishment. The Sinker-Davis Company is getting up a complete power plant for the establishment, including engine and boilers.

F. E. Brown and C. Gardiner, Auburn, Me., have commenced the manufacture of shoe dies in the Bonney building on Miller street, under the firm name of Brown & Gardiner.

After an idleness of nearly eight months, the North Athens (Tenn.) Cotton-mills have resumed operations. When in full running capacity, about 300 people will be employed.

China, Maine, is likely to have a new steam saw, shingle and grist-mill built this season. A subscription paper has been circulated and numerously signed to aid the enterprise.

A company has been organized at Statesville, N. C., to erect a cotton mill. Capital stock subscribed, $60,000. Incorporators—T. D. Miller, William Wallace, M. R. Adams and others.

Superintendent Spofford, of the recently burned, Bridgton (Me.) Leather Works, says that the prospect of rebuilding the tannery is encouraging, as the company offers to take a ten years' lease.

Colby Getchell, Waterville, Maine, is about to start a large new shirt manufacturing establishment. Mr. Getchell has been for a long time the foreman in the Hathaway shirt factory in that city.

The water-works company is extending its mains to the Lauter Furniture Manufactory, the Indiana Foundry Company's new plant, and other manufactories on Harding street, west side, at Indianapolis, Ind.

The Falcon blast furnace of the Brown-Bonnell Iron Company, of Youngstown, O., will be torn down. It was erected nearly forty years ago. It will be replaced by a new furnace equipped with all modern appliances.

The people of Richmond, Me., are to hold a fair for the purpose of aiding in purchasing, transporting and setting up machinery at the shoe factories, which the Citizens' Building Association is endeavoring to start in operation.

H. B. Shields, manager of the Mattie furnace at Girard, O., which is turning out 240 tons of pig-iron per day, says the outlook has improved, and that purchasers are now looking for iron, instead of producers hunting for buyers.

The Creston Oil and Gas Company was incorporated recently, with its principal office at Creston, Wirt County, W. Va. The capital is $520, with the privilege of increasing to $1,000,000. M. Vandoll and others of Creston are the incorporators.

The iron-mill at Kittanning, Pa., has resumed work after five months' idleness. The Isabella blast furnace, which furnishes pig-iron for the same plant, has also resumed. It had not been operated for more than two years. Two hundred men are employed.

The Peerless Ribbon Company, of New York City, has been incorporated at Albany, to manufacture and deal in silk and other fabrics. The capital is $40,000, and the directors are Augustus L. Hollinshead, Edwin L. Kalish and Oscar G. Kalish, all of New York City.

A. A. Barnes, proprietor of the Udell woodenware works, Indianapolis, Ind., will in a few days let the contract for another large addition to his plant. The new building will be constructed of brick, resting on a stone foundation, 200 feet long by 160 wide, and five stories high.

A manufacturer of structural iron says: "Everything points to a prosperous year. Aside from capitalists who are erecting mammoth structures as an investment, the United States government is becoming a large customer for structural iron because of the activity in the erection of public buildings."

The Penobscot Machine Company, Bangor, Maine, have moved into quarters on the east side of Broad street, and in their new location will have much better facilities for the transaction of their large and steadily increasing business. They are putting in a new and larger engine, and are making other additions to their equipment.

H. W. Knight & Son, of Seneca Falls, N. Y., makers of pattern letters and figures, have recently gotten up patterns ranging from 3/16 to 7/8 inch inclusive, of extra thin roman letters, specially adapted for stove manufacturers or others requiring a thin letter. The hair line gothic letters, also a new style, are used for the same purpose.

The N. A. & S. H. Burpee Furniture Company has been organized in Rockland, Maine, with $50,000 capital stock, for the purpose of manufacturing and selling all kinds of furniture, and carrying on the undertaking business in all its branches. Samuel H. Burpee is president, Edgar A. Burpee, secretary and treasurer, and these two and Richard H. Burpee, directors.

It is currently reported that the Manufacturers' Investment Company are to make a large addition to the digester room of their big sulphite pulp-mill at Madison, Me., and also to construct immediately a large paper mill. The paper-mill will be located on the Anson side of the river, just opposite the pulp mill, the two being connected by an iron bridge over the river.

The Duquesne Forge Company at Rankin station, Pa., has completed a shaft for a new mill at the Homestead Steel Works of the Carnegie Company. It is one of the largest ever made in Pennsylvania. The ingot weighed twenty tons, and was nine feet long and twenty-seven by fifty-seven inches in thickness. It was hammered out to a length of sixteen feet and a diameter of twenty-two inches.

The Crystal Spring Creamery Company, lately organized at Portland, Maine, with a capital stock of $10,000, will establish a plant at Unity, Maine, for the purpose of manufacturing butter and cheese, and the buying and selling of dairy and farm produce. The officers of the company are Thomas P. Shaw, president; Frank L. Oakes, treasurer; Thomas P. Shaw, Frank L. Oakes and Rufus G. Fuller, directors.

The Berlin Iron Bridge Co., of East Berlin, Conn., have received the contract for a new bridge at Norwich, Conn., to span the tracks of the Norwich & Worcester branch of the N. Y. & N. E. R. R. over the Shetucket River. The bridge will consist of one span of 145 feet with a roadway 24 feet wide in the clear and two sidewalks each 5 feet wide in the clear. The roadway and sidewalks will both be covered with steel buckle plates and concrete.

There is considerable activity at Woonsocket R. I. The Fairmount Farm Co. has decided to at once build a three-story factory building 200x60 feet beside the Consolidated R. R. tracks. The Harris Woolen Co. has sold its No. 2 and 3 woolen mills on Main street, idle for several years, to a woolen concern, name not yet given, and operations will be resumed there. The River Spinning Co., better known as Belgian Yarn Concern, will this summer duplicate its present buildings built in 1892.

It is understood that the Chicago & Eastern Illinois Railroad Company will at once extend its line from Shelbyville, Ill., to St. Louis, Mo., so as to have a through line for its World's Fair traffic. A corps of surveyors is said to be ready to go in the field this week, or as soon as the weather permits. If constructed, the line will be one of the short lines from St. Louis to Chicago, and will run through one of the richest and wealthiest sections of Illinois.

The Totten & Hogg Iron and Steel Foundry Company, Twenty-fourth and Railroad streets, Pittsburgh, Pa., have remodeled their plant. New engines and new tools of the latest design have been put in. The company has plenty of orders for rolling-mill machinery, and is running day and night. The Wheeler Furnace Company, of Sharon, Pa., has decided to start the Alice furnace at Sharpsville, Pa., and the Sharpsville Iron Works, both plants having been idle for several months. It is also reported that the West Middlesex (Pa.) furnaces, undergoing repairs, will go into blast.

Every department of the Cambria Iron Works, at Johnstown, Pa., employing several thousand men, is running day and night. There are enough orders in to keep the works in operation for a year. A train of rolls with a daily capacity of 150 tons of billets has just been added to the finishing department. At the Cambria two trains of rolls are running every hour of the twenty-four, turning out rails for street railways. The stock on hand will reach 8,000 tons. The Cambria Iron Company has six blast furnaces in operation, turning out over 1,000 tons of pig-iron daily, and yet the company finds it necessary to buy pig metal from other concerns.

There is water-works agitation at West Bridgewater, Mass; McSherrystown, Pa.; Branford, Conn; Newburyport, Mass.; Montreal, Can.; Lincoln, Neb.; Tacoma, Wash.; Ithaca, N. Y.; Sewickley, Pa.; Mukwonago, Wis.; Yalesville, Conn.; Barnesville, Ga.; Walpole, Mass.; Providence, R. I.; Marlboro, N. Y.; Boonton, N. J.; Sante Fe, N. M.; Detroit, Mich.; Steubenville, O.; Pittsburgh, Pa.; Laredo, Tex.; Lebanon, Pa.; Winnetka, Ill.; Lynchburg, Va.; Alpena, Mich.; Waupaca, Wis.; Hoquiam, Wash; Mount Vernon, Wash.; Bar Harbor, Me.; Forest City, Ia.; Horton, Kan; Albany, N. Y.; Lancaster, O.

Mr. Henry Wick, a heavy stockholder of the Ohio Steel Company at Youngstown, Pa., furnishes some information about the new plant being erected there. He says: "The capacity will range from 1,000 to 1,400 tons of finished steel per day, and the constant operation of four large blast fur-

naces will be necessary to furnish pig-iron. The plant is being erected on a fifty-acre tract, underlaid with rock, furnishing a solid foundation for the engines and ponderous machinery. From 800 to 1,000 men will be employed." The capital stock has been increased from $750,000 to $1,000,000, the increase being taken by two capitalists one a Cleveland man, the other a resident of Youngstown.

Colonel Philip H. Moore, of Wheeling, W. Va., editor of the *Ohio Valley Manufacturer*, says that the iron business is in a very promising condition. While the demand for Bessemer pig is not quite so great as it was three weeks ago, there has been no decline in prices, and there are good prospects for an advance before this month closes. The market in soft steel billets and slabs is strong, and if the manufacturers of finished steel products could operate their works full time, the output of billets and slabs would not equal the consumption, and such a condition is likely to continue until July 1, the transition from iron to steel being so rapid. The Colonel says he finds the iron manufacturers of both the Wheeling and Pittsburgh districts confident and in good spirits.

Machinists' Supplies and Iron.

NEW YORK, April 1, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.50 to $15.25; No. 2, $13.75 to $14.50; Gray Forge, $12.75 to $14. Southern brands of good quality are obtainable at $14.25 to $14.75 for No. 1 Foundry; $13.25 to $14 for No. 2; and $12.25 to $13 for Gray Forge.

Antimony—The market is steady. We quote L. X., 10¾c. to 10½c.; Cookson's, 10½c. to 10¾c.; Hallett's, 10c. to 10⅛c., and U. S. French Star, 10¼c.

Copper—The market is dull. Lake Copper is nominal at 11¾c. to 12c. Casting Copper is held at 10¾c. to 11c.

Lead—The market is firm, with 4.05c. asked for prompt or near delivery. Some business is reported at this price.

Lard Oil—Prime City is quoted at 90c. to 92c.

Spelter—The market is firm; holders appear to be uniform in their views at 4.30c., but no important business is reported.

Tin—The market is easier, with accumulation of supplies. There are sellers of prompt delivery at 20.40c. Some sales have been made at 20.75c. to 20.90c, and for May at 21c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Salesmen on commission, to push a special line of mach'y. "Kirk," care of AM. MACH.

Draftsman (designer), machine tools, fixtures and general mach'y, desires pos'n. H. M., AM. MACH.

Mech'l draftsman, exp'd in hoist'g & mill mach'y, & plants, wants position; refs. Box 68, AM. MACH.

Wanted—Machinery molders; steady work. Gardner Governor Co., Quincy, Ill.

Mech draftsman wishes pos. on steam engines; best refs. F. F. Kirpal, 128 W. 61st St., N. Y.

Wanted—Foremanship; engines, pumps or general jobbing. Indicator, AMERICAN MACHINIST.

Boiler maker foreman wants position; steady experienced man, aged 35. Box 74, AM. MACHINIST.

First-class draftsman wants position. Box 73, AMERICAN MACHINIST.

Wanted—Situation by 1st-class mech. draftsman & designer, 16 yrs.' exp. in marine & sta'y eng. and gen. mach'y, 1st-class refs. furnished. 62, AM. MACH.

Cost accounts are my specialty; gen'l office exp., quick and accurate draftsman; mach'y my line; large concerns address P. B. Cheek, AM. MACHINIST.

Wanted—Situation by young man; some experience in mechanical drawing and surveying. Box 77, AMERICAN MACHINIST.

Wanted—One good pattern maker and a few good molders; only competent men need apply. Miller Steam Pump Co., Dixon, Ill.

Position by engineer and draftsman as assistant sup't or private draftsman; will take entire charge of work and men. N. D., AMERICAN MACHINIST.

Wanted—A practical boiler maker to take interest in a small shop. Address W. Bartley & Sons, Bartley, N. J.

Wanted—Foreman for smith shop; must be well up in his business, & a good manager; further particulars on applica'n to Frick Co., Waynesboro, Pa.

Wanted—Foreman for machine shop; fifty hands; engine building and general iron work. Address, with references. Box 66, AM. MACHINIST.

Wanted—Three first-class machinists for light machinery and tools; permanent situation. Address American Optical Co., Southbridge, Mass.

Wanted—Machinist in a machinery store for doing odd repair jobs and general work, packing, etc. Address, stating exp., etc., Box 72, AM. MACHINIST.

Wanted—A good live machinist to work in large factory. Address O. T. Stantial, 211 Webster Ave., Chicago.

First class pattern maker desires situation as foreman; experienced in heavy machine tools, etc. Age, 36. Address Box 60, AMERICAN MACHINIST.

Wanted—1st-class brass molder to take charge of foundry. State experience and salary. Apply James Morrison Brass Mfg. Co., Toronto, Ont.

Wanted—A mechanical engineer, a graduate who has had some shop exp.; also 2 mechanical draftsmen exp'd in general engine and machine work. F. W. E., Room 40, Coal Exchange, Scranton, Pa.

Wanted—Pattern makers on heavy machinery work. None but 1st class workmen of good habits need apply. Farrel F'd'y & Mach. Co., Ansonia, Ct.

Wanted—By a superintendent of machine, foundry and boiler works, a similar position after May 1st; specialties, hydraulic, sugar, steam and power machinery and ordnance. Box 71, AM. MACHINIST.

Foreman in iron foundry, one familiar with all kinds of light and heavy machinery in green dry sand and loam; best of references from last employer. Address C., AMERICAN MACHINIST.

Mech. engineer wants situation as supt., assistant supt., or chief draftsman. 15 years' practical experience on machine tools, eng. and electric machinery; best refs. Theory & Practice, AM. MACH.

Wanted—Superintendent or general foreman for machine shop doing general work and repairs; good opening for competent and progressive man; stating age, experience and salary expected, address Box 75, AMERICAN MACHINIST.

Wanted—A practical machinist, well up on jig and tool making, and competent to take position of foreman of a small but well established and growing concern; manufacturing a specialty. Address P. S., AMERICAN MACHINIST.

We will pay 25 cents each for copies of the AMERICAN MACHINIST of December 4, 1886 issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Wanted—Member A. S. M. E., superintendent of large works, desires similar position in Philadelphia about June 1st. 18 years exp. covering machine tools, general machine and iron work, & electric railroad & lighting mach'y. Box 59, AM. MACH.

Wanted—Position as draftsman or assistant superintendent in a Corliss engine mfg establishment, six years prac'l exp. as pattern maker and erecting engineer and worked a number of years in drawing room and is thor. acquainted with the principle of compound & single Corliss eng. O. M., AM. MACH.

(*Continued on page* 12.)

Bradley Hammers.

If you plate, draw, square, taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a BRADLEY HAMMER will soon pay for itself, by what it will save over any other similar tool. Send for circulars.

BRADLEY & COMPANY, SYRACUSE, N. Y.

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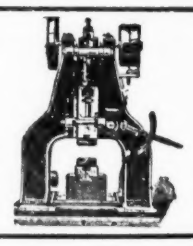
Meet all requirements more fully and satisfactorily than any other of its competitors.

INVESTIGATION IS NOT COSTLY.
INVESTIGATION IS CONVINCING.



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Cleveland, Ohio.

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3/16" 5/16" 1/4"

For Pattern Makers. 8 Sizes.
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Perfect Allignment Of Blade.

Will cut STEEL at an angle.

Frame rises on return stroke, saving wear on blades.

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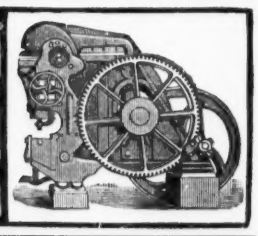

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HIGH QUALITY. LOW PRICE. SEND FOR SAMPLE.

UNION ELECTRIC COMPANY,
Manufacturers and Sole Agents, 45 BROADWAY, N. Y.

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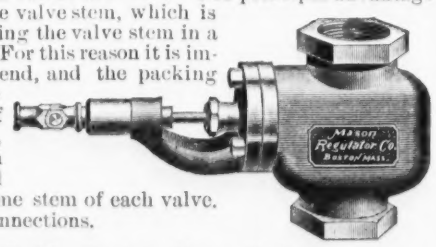
Is a double piston or seated balanced valve, for which we have found a ready sale in the many cases where such valves are used. The principal advantage of our valve is in the guide for the valve stem, which is cast on the bonnet, thereby keeping the valve stem in a direct line with the stuffing box. For this reason it is impossible for the valve stem to bend, and the packing seldom has to be renewed. The sizes up to two inch are made of the best steam metal; above that, of cast iron, lined with steam metal. A knuckle-joint tapped for three-eighths rod is on the same stem of each valve. This saves expense in making connections.



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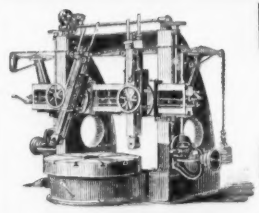

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Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.

Wanted—A position; 12 years' experience in shop and drafting room work; at present hold position as superintendent of the Ferracute Machine Co.; a member of the A. S. M. E. Address Chas. D. Reeve, Bridgeton, N. J.

Wanted—A competent, energetic foreman; must be a pusher and a man of good habits, familiar with the best practice on lathe press and milling machine work, looking after about twenty men; also draftsman having experience in designing milling machines and special tools, jigs, etc.; state age, experience and wages exp'd, R. W., Am. Machinist.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers S. M. York, Clev'd, O

Auto Steam Flue Cleaners. Kelley Co., Erie, Pa.

Wanted—About 12" eng. lathe. Box 76, Am. Mach.

Wanted—A Medart shaft straightener; must be in A1 cond'n; state cap'y. Address Shafts, Am. Mach.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Gang & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

London Engineering from commencement to date for sale. Address "Boston," Am. Machinist.

For Sale—36" gear cutter, extra heavy, new; one 300 lb. steam hammer; one 16" monitor turret lathe. A. L. Henderer, Wilmington, Del.

For Sale—Upright engine, new, 5 horse power, 5"x5" cylinder, and 20"x5 feet upright boiler, new. All guaranteed; only $181, spot cash. Wm. C. Codd, Baltimore, Md.

We have for rent a new brick foundry near Chicago fully equipped for either green or dry sand work with Collian cupola, five-ton steel crane, core oven, power elevator, fan, etc.; we will take castings to the amount of $5,000 at regular market rates. Address Box 78, American Machinist.

SECOND-HAND MACHINERY.

SCREW-CUTTING LATHES.

3 14 in.x6 ft.	2 17 in.x6 ft.
1 15 in.x6 ft.	1 17 in.x8 ft.
1 16 in.x6 ft.	1 22 in.x9 ft.
1 16 in.x7 ft.	1 26 in.x16 ft
1 16 in.x8 ft.	1 29 in.x10 ft.

PLANERS.

1 18 in. Crank	1 36 in.x36 in.x9 ft.
1 24 in x24 in.x6 ft.	1 37 in.x40 in.x9 ft.
1 28 in x28 in x7 ft.	1 40 in.x36 in.x10 ft.
1 30 in.x30 in.x8 ft.	

MISCELLANEOUS.

1 15 in. Shaper.	2 24 in. Shapers.
2 15 in x5 ft. Plain Turret Lathes.	
1 15 in. Automatic Turret Lathe.	
1 14 in.x5 ft. Screw Machine.	
1 No. 3, 5 and 10 Stiles Press.	
1 No 18, 19 and 21 Bliss Press.	
4 Squaring Shears.	
1 30 in. Automatic Knife Grinder.	
1 No. 2 Pratt & Whitney Double Bolt Cutter.	
1 No. 4 Garvin Milling Machine.	
1 6 in. Slotter.	1 50 in. Pulley Lathe.

500 TOOLS IN STOCK.

Send for Circular with description of second-hand tools, and get our prices, before buying.

IT WILL PAY YOU.

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Laight and Canal Sts., New York City, N. Y.

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Planers.	62 in.x22 ft.	1 Head.	Planers.	31 in.x8 ft.	1 Head.
"	54 in x24½ ft.	2 "	"	30 in.x7 ft.	1 "
"	44 in.x16 ft.	1 "	"	26 in.x7 ft.	1 "
"	36 in x12 ft.	1 "	"	25 in.x5 ft.	1 "
"	22 in.x5 ft.	1 "	"	24 in x5&6 ft.	1 "
"	15 in.x3 ft.	1 "	"	20 in.x4 ft.	1 "

80 in.x18 ft. Engine Lathe Geared Face Plate.
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32 in.x12, 14, 16, 18 ft. Bed. New Engine Lathe.
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25 in.x12, 16, 20 and 24 ft. Bed. New do do
21 in.x10, 12 ft. Bed. do do do
20 in.x 5, 6 & 8 ft. do 2d Hand do do
18 in.x 6, 7 & 8 ft. do New & do do do
17 in.x 8 ft. do do do do
16 in.x 6 & 8 ft. do do do do do
15 in.x 6 & 8 ft. do do do do do
14 in.x 6 ft. do do do do do
Car Axle Lathe, Bement. | Driving Wheel Lathe 88 in.
15, 16, 18, 25 in. Crank Shapers. | Wheel Quartering Mach.,
20, 24, 26 & 30 in. Geared Shapers. Double.
20, 22 24, 28, 30 & 36 in Drills. | No. 0 Turret Lathe, Am. Tool and Mach. Co.,
Bolt Cutters. | 24 in. Swing, 8 ft. Bed.
8 and 13 in. Stroke Slotters.
Lot of Lincoln Pattern Millers and No. 1 P. & W. Millers.
2 Spindle Drills. Garvin. No. 75 Bliss Press Geared.
O'Brien's Boiler Head Flanging Mach.; Gear Molding Mach.
1100 and 3000 lb. Bement Steam Hammer.
100 lb. Steam Hammer.
40 H. P. Vert. Engine. N. Y. S. S. P. Co. | SEND FOR MARCH LIST.
11 in.x18 in. Hor. Engine. At Order.
14 in.x36 in., 16 in x42 in. Corliss and 16 in.x48 in. Brown Eng.
300 H. P. Westinghouse Comp'd Engine.

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TOLEDO, OHIO,
Manufacture The Best and Most Complete Line of Hand And Power

PIPE THREADING MACHINERY IN USE.

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We will close out at low prices previous to time of our removal the following

SECOND-HAND MACHINE TOOLS.

Engine Lathe, 43 in. swg., 10 ft. bed—Screw Feed, Cpd. Rest, and 43 in. Face plate. Price, $200.
Engine Lathe, 24 in. swg., 5½ ft between centers—Hollow Spindle, 1⅝ in. hole and complete with Chuck. A1 order
Engine Lathe, 20 in. swg., 18 ft. complete with Rod and Screw feeds and 19 in. Chuck (Lathe & Morse). Good order.
Engine Lathe, 18 in. x 8 ft. complete, (New Haven).
" " 18 in. x 6 ft., " (Gage). Price, $115
" " 17 in. x 9 ft., " (Lathe & Morse). " $100
" " 16 in. x 7 ft., " (old style). " $50
" " 16 in. x 8 ft., " with Chuck, "modern." A1
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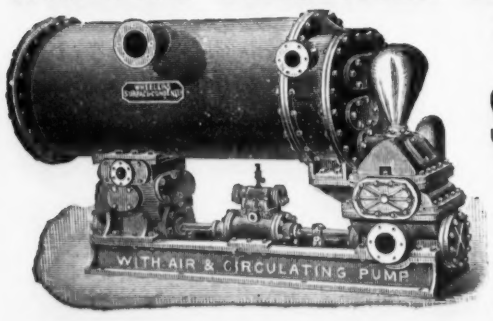

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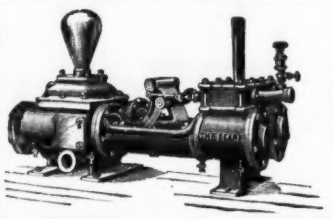

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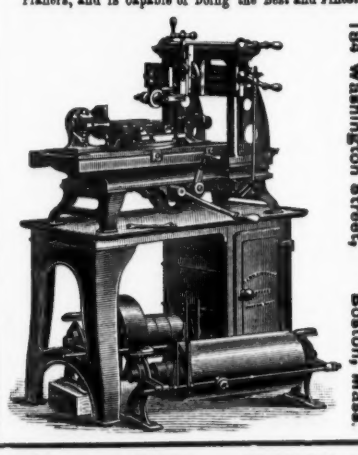

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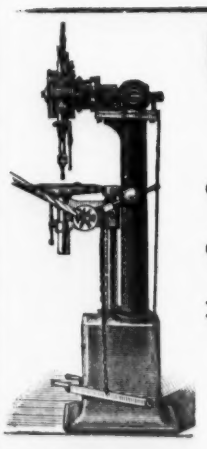

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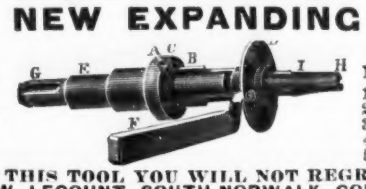

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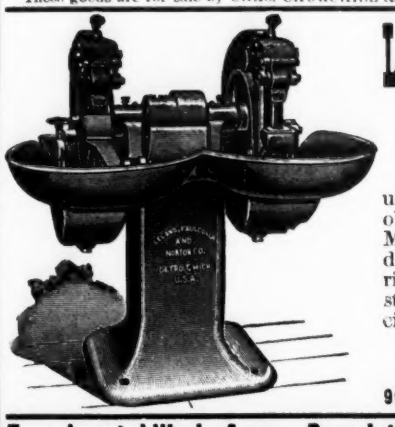

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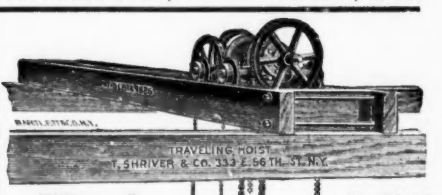

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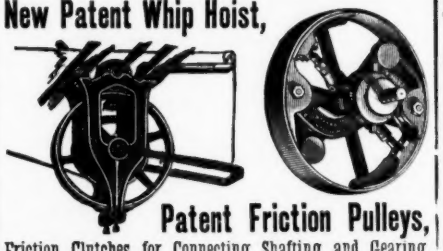

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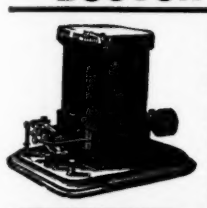

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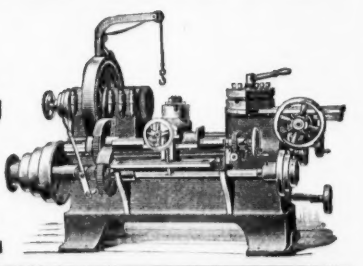

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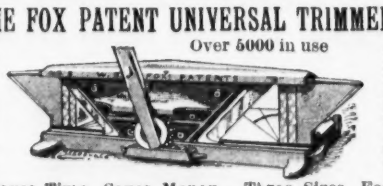

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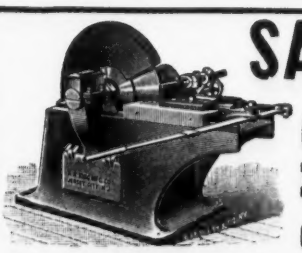

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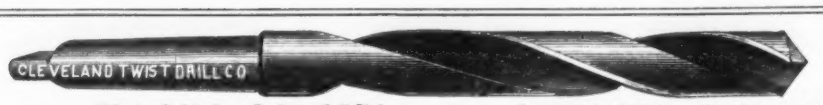

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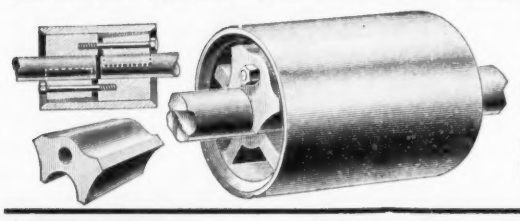

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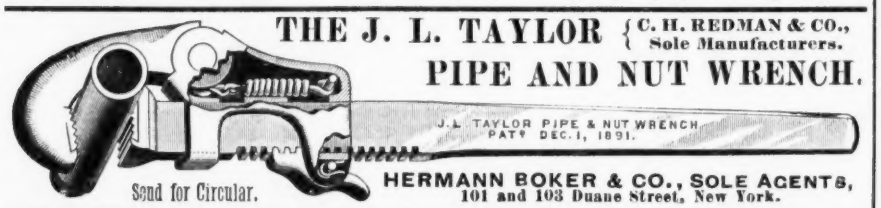

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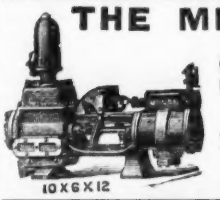

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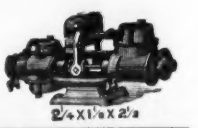

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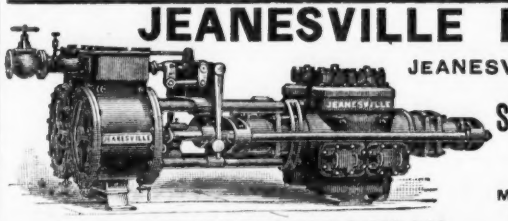

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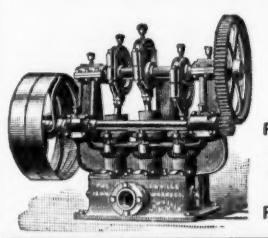

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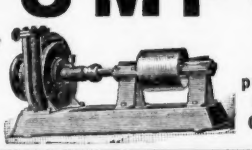

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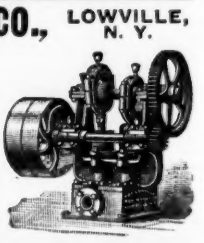

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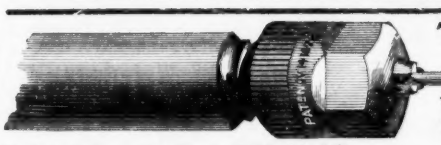

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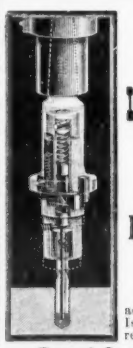

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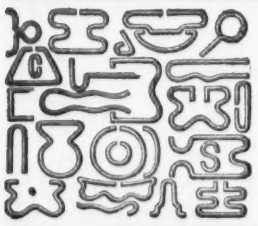

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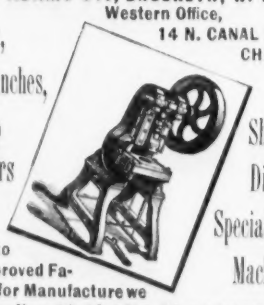

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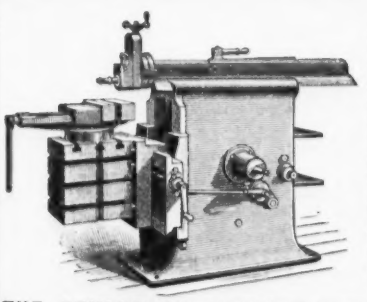

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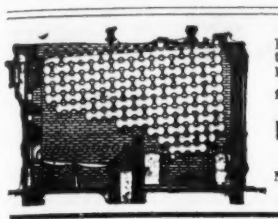

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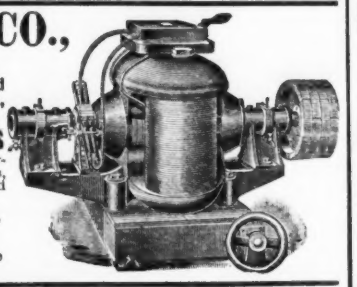

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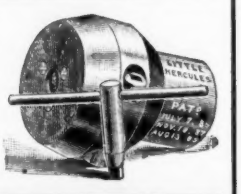

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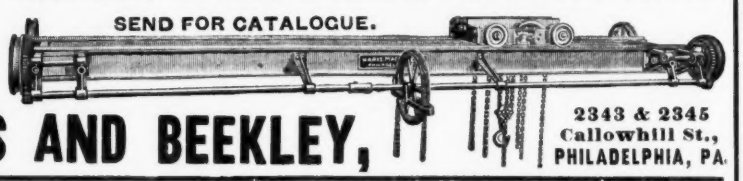

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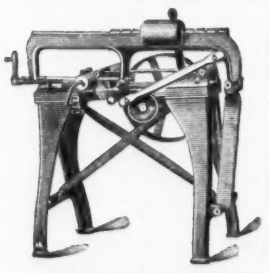

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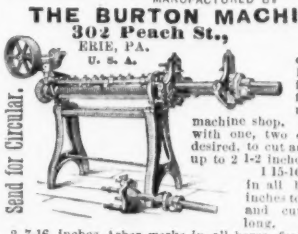

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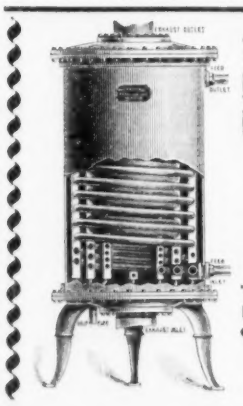

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13 "	13 1-8 "
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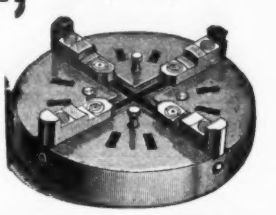
18 "	19 3-4 "
21 "	25 1-2 "
24 "	28 "
30 "	32 1-2 "
36 "	40 "



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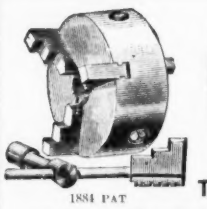
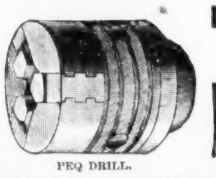

1884 PAT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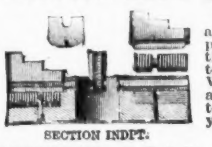
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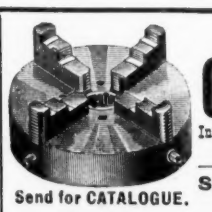

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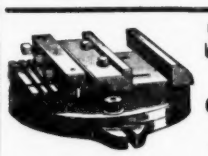

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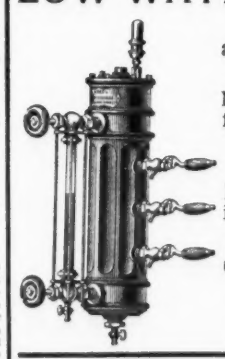

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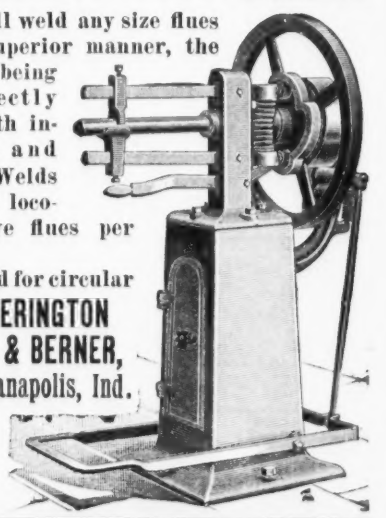

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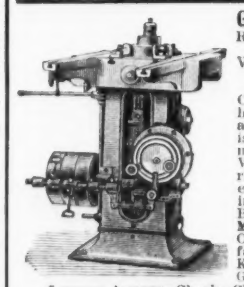

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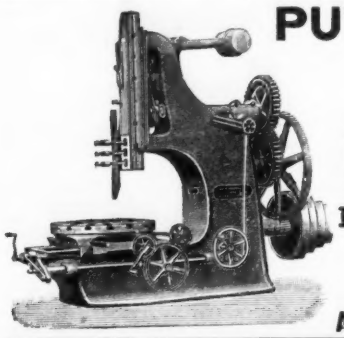

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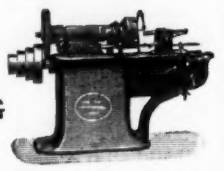

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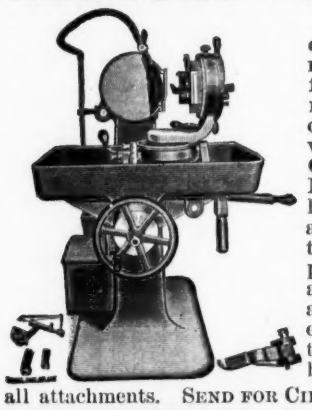

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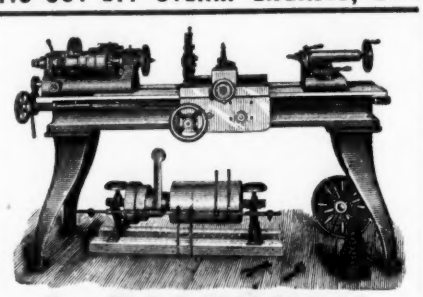

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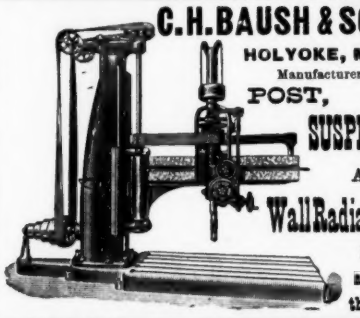

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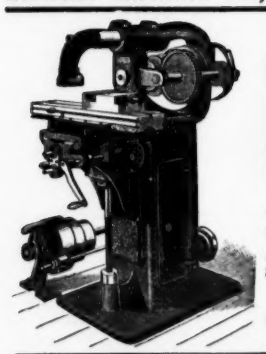

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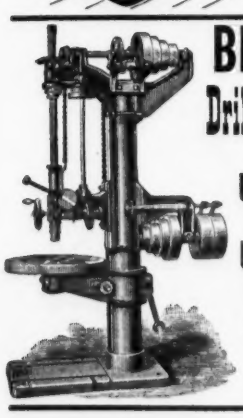

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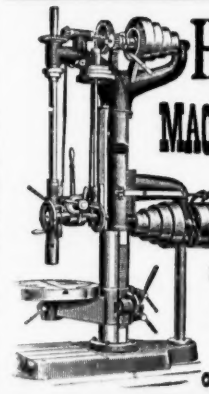

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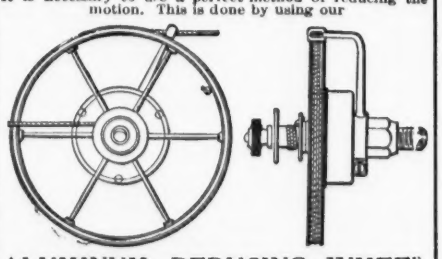

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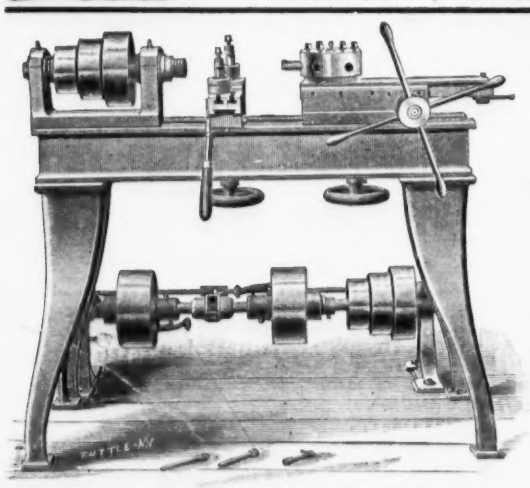

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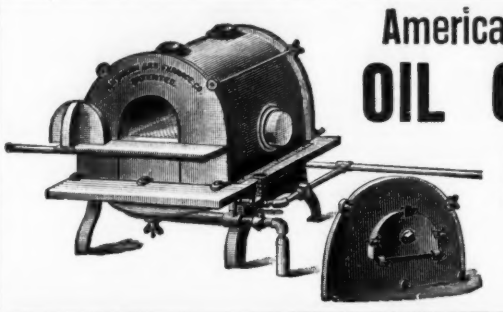

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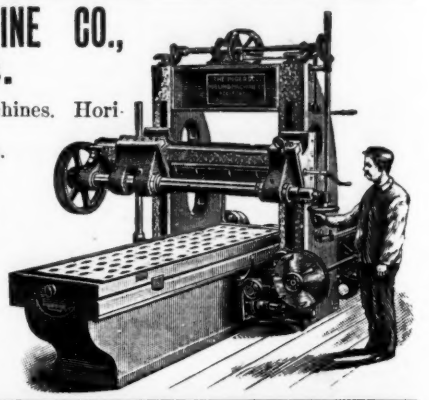

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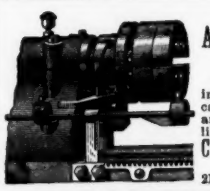

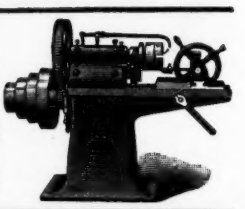

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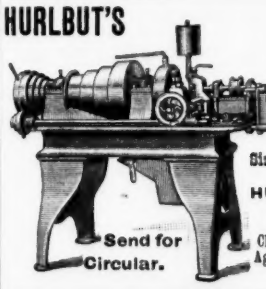

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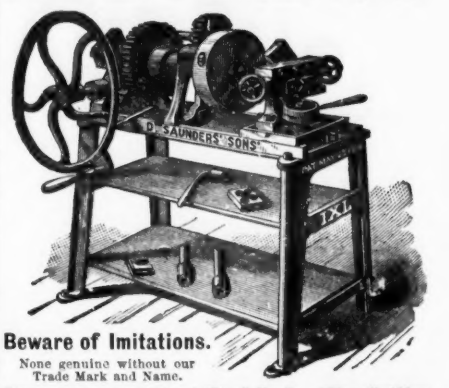

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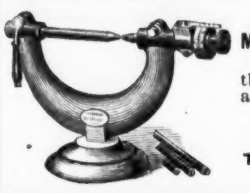

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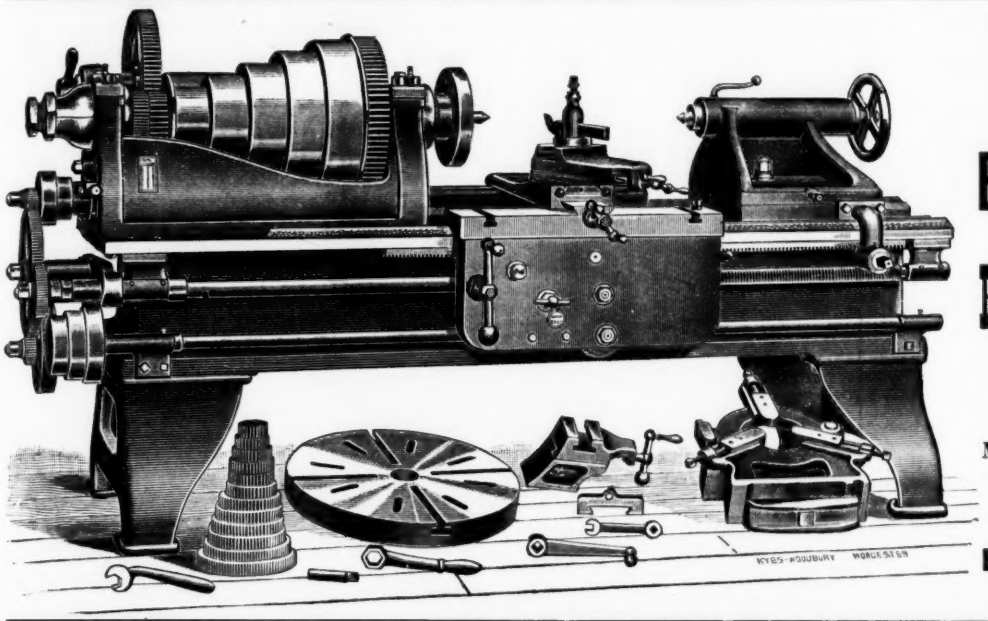

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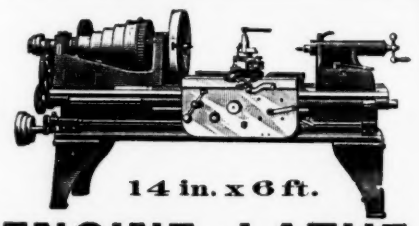

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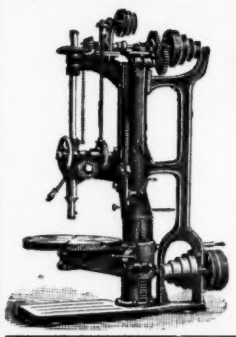

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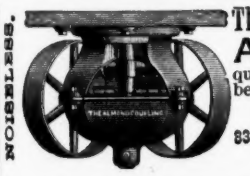

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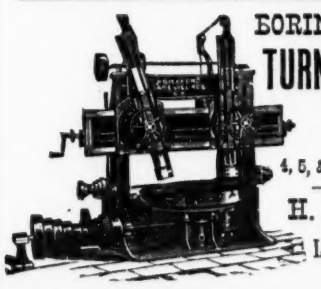

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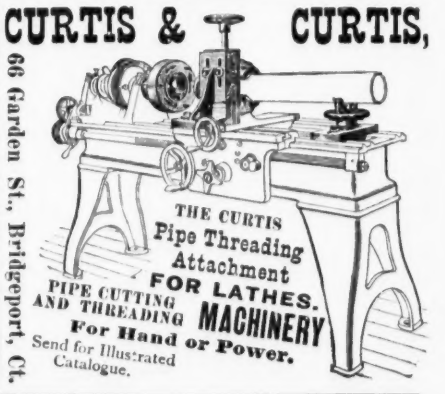

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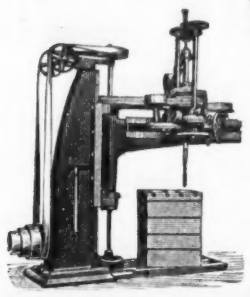

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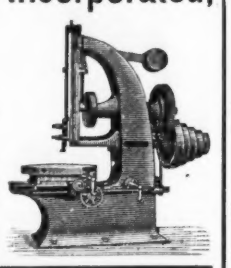

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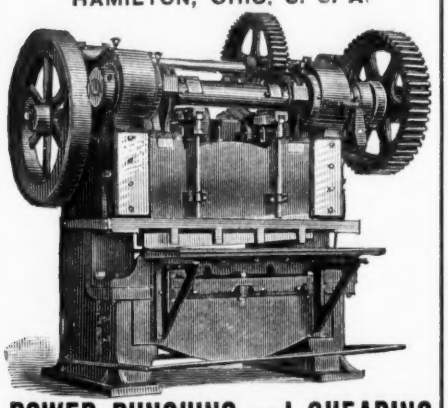

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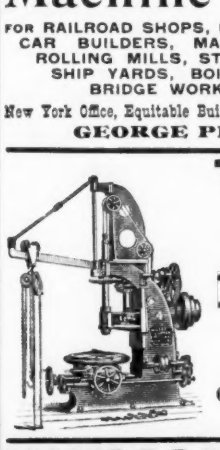

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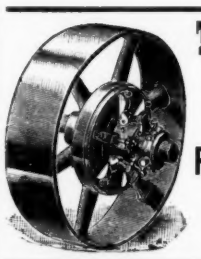

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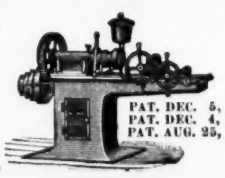

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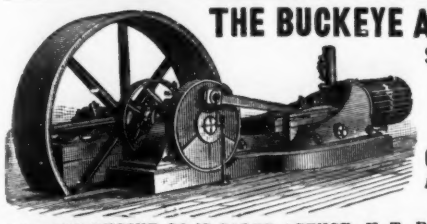

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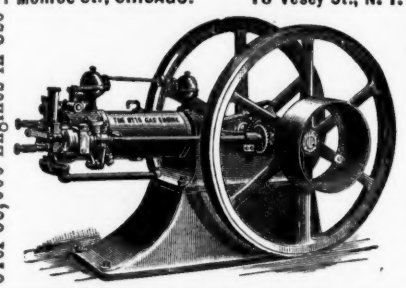

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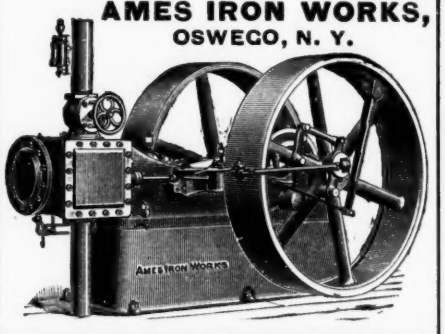

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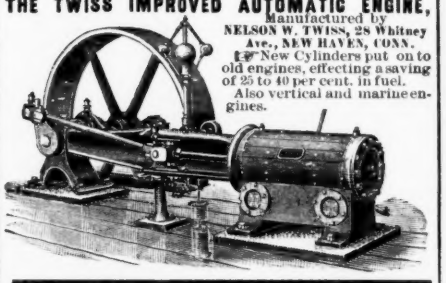

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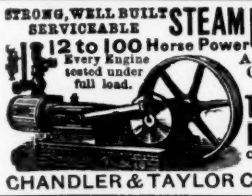

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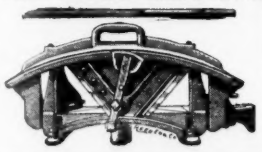

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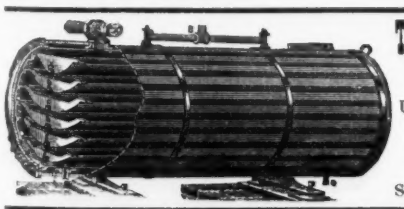

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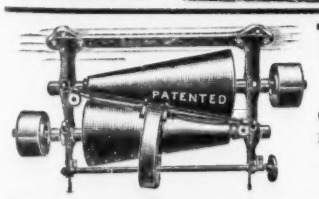

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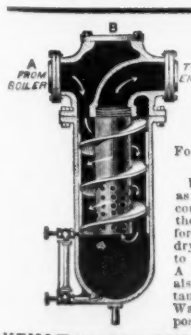

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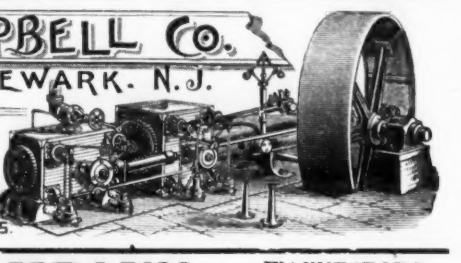

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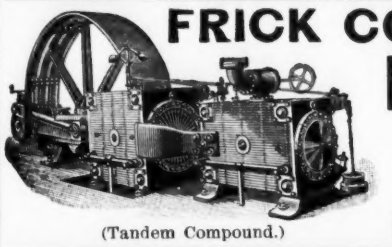

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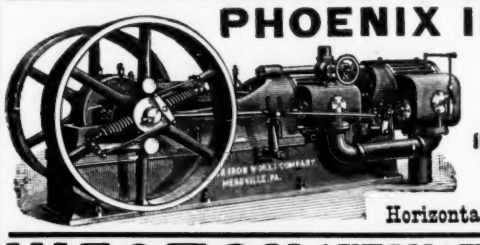

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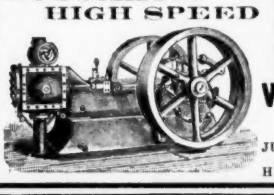

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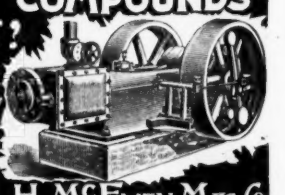

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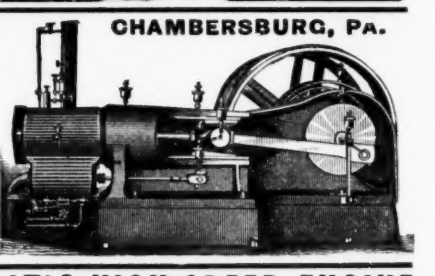

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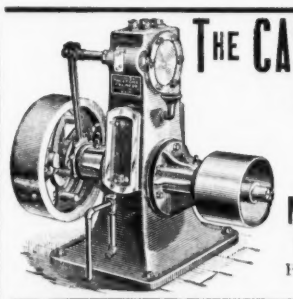

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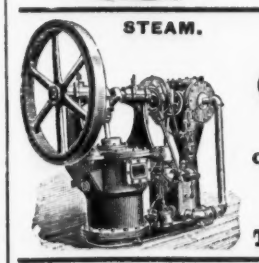

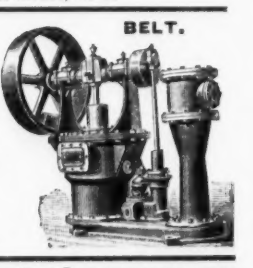

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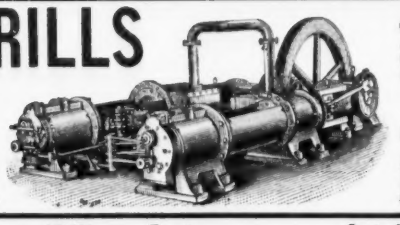

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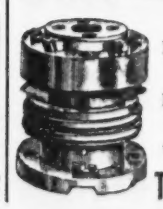

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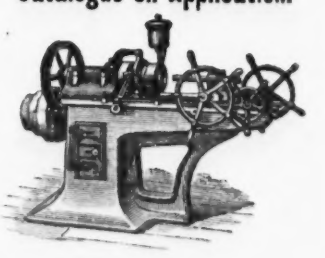

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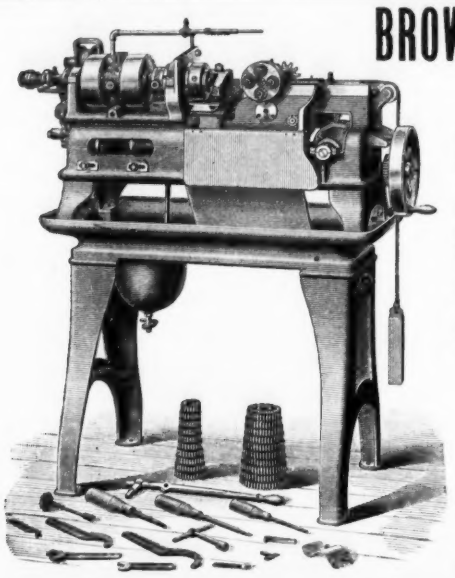

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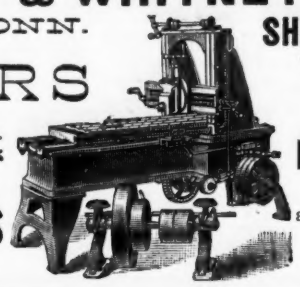

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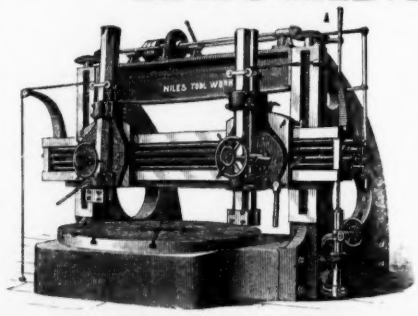

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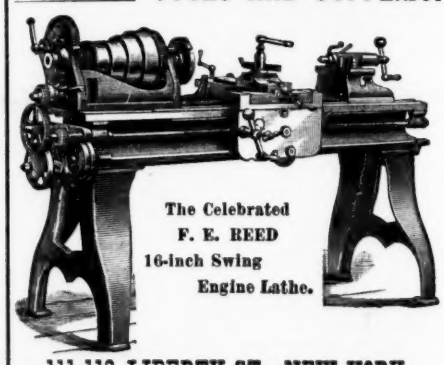

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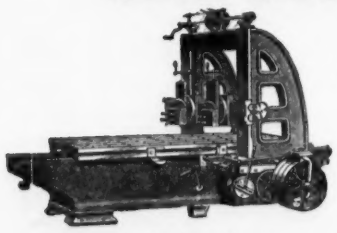

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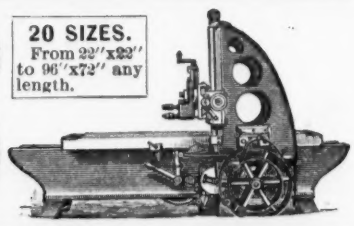

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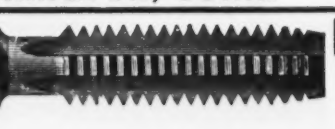

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